vSphere Basic System Administration

Update 1
ESX 4.0
ESXi 4.0
vCenter Server 4.0

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Updated Information

This *vSphere Basic System Administration Guide* is updated with each release of the product or when necessary.

This table provides the update history of the *vSphere Basic System Administration Guide*.

Revision	Description
EN-000260-06	Changed a point in "Configuring Communication Among ESX, vCenter Server, and the vSphere Client," on page 49 section.
EN-000260-05	■ The topics "Windows Requirements for Guest Customization," on page 178 and "Linux Requirements for Guest Customization," on page 179 now have reference to the *vSphere Compatibility Matrixes* document for information on the list of operating system that are supported for guest OS cutomization. ■ The topic "About Snapshots," on page 205 now reflects that VMware does not support snapshots of virtual machines configured with bus-sharing.
EN-000260-04	■ In certain topics, removed references to Microsoft Outlook Express. ■ In "Upgrade VMware Tools Manually," on page 131, updated Step 5 to show that you do not have to power-off the virtual machines when upgrading VMware Tools manually. ■ In "Install VMware Tools on a Linux Guest with the Tar Installer," on page 126, updated Step 10 to remove information about RPM installation over a tar installation. ■ In "Install VMware Tools on a Linux Guest with the RPM Installer," on page 127, updated Step 10 to correct the information about installing the RPM package.
EN-000260-03	■ In "Specify an IP Address Range," on page 111, updated the incorrect IPv4 address from 10.209.60.13 to 10.20.60.13. ■ In Chapter 17, "Using Snapshots," on page 205, added information that you can use snapshot as a restoration point during a linear or iterative process. ■ In "About Snapshots," on page 205, added a link to a KB article. ■ In "Revert to Snapshot Command," on page 209, added information about taking the snapshot when the virtual machine is powered off. ■ In "Collection Intervals," on page 269, updated that ESXi retains real-time statistics for one hour instead of 30 minutes. ■ In "Disk Metrics," on page 337, updated the Stats Type as rate and Unit as kiloBytesPerSecond in the usage counter of the Table C-3.
EN-000260-02	■ In "Linux Requirements for Guest Customization," on page 179 added new Linux Guest Operating Systems. ■ In "Windows Requirements for Guest Customization," on page 178 added new Windows Guest Operating Systems.

Revision	Description
EN-000260-01	■ In "Edit vApp Startup and Shutdown Options," on page 108 the tab name is changed from Start Up to Start Order. ■ A note added to "View vApp License Agreement," on page 109 clarifies the condition required to view the vApp license agreement. ■ "Add a Paravirtualized SCSI Adapter," on page 165 incorrectly stated that Paravirtual SCSI adapters do not support bootable disk. This statement is deleted. ■ The alarms Virtual Machine CPU Ready, Virtual machine disk commands canceled, and Virtual machine disk reset are removed from the Default VMware Alarms table in "Preconfigured VMware Alarms," on page 264. ■ "How Metrics Are Stored in the vCenter Server Database," on page 273 now reflects that the maximum number of years for which the vCenter Server Database can store statistical data is 5 years.
EN-000260-00	Initial release.

About This Book

This manual, *Basic System Administration*, describes how to start and stop the VMware® vSphere™ Client components, build your vSphere environment, monitor and manage the information generated about the components, and set up roles and permissions for users and groups using the vSphere environment. This manual also provides information for managing, creating, and configuring virtual machines in your datacenter.

In addition, this manual provides brief introductions to the various tasks you can perform within the system as well as cross-references to the documentation that describes all the tasks in detail.

Basic System Administration covers ESX, ESXi, and vCenter Server.

Intended Audience

The information presented in this manual is written for system administrators who are experienced Windows or Linux system administrators and who are familiar with virtual machine technology and datacenter operations.

Document Feedback

VMware welcomes your suggestions for improving our documentation. If you have comments, send your feedback to docfeedback@vmware.com.

VMware vSphere Documentation

The vSphere documentation consists of the combined VMware vCenter Server and ESX/ESXi documentation set.

Abbreviations Used in Figures

The figures in this manual use the abbreviations listed in Table 1.

Table 1. Abbreviations

Abbreviation	Description
database	vCenter Server database
datastore	Storage for the managed host
dsk#	Storage disk for the managed host
hostn	vCenter Server managed hosts
SAN	Storage area network type datastore shared between managed hosts
tmplt	Template

Table 1. Abbreviations (Continued)

Abbreviation	Description
user#	User with access permissions
VC	vCenter Server
VM#	Virtual machines on a managed host

Technical Support and Education Resources

The following technical support resources are available to you. To access the current version of this book and other books, go to http://www.vmware.com/support/pubs.

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Getting Started

vSphere Components 1

VMware vSphere™ includes components and operations essential for managing virtual machines. vSphere works with several client interfaces and offers many optional components and modules, such as VMware High Availability (HA), VMware VMotion™, VMware Distributed Resource Scheduler (DRS), VMware Update Manager, and VMware Converter Enterprise.

vSphere allows you to treat your virtual environment objects as managed components such as virtual machines, hosts, datacenters, resource pools, and clusters. Functional components of vSphere provide the best way to manage each of these managed components of your virtual environment.

Finally, vSphere provides powerful administration tools through access privileges components.

This chapter includes the following topics:

- "Components of vSphere," on page 15
- "vSphere Client Interfaces," on page 17
- "Functional Components," on page 17
- "Managed Components," on page 19
- "Access Privileges Components," on page 21
- "vCenter Server Plug-Ins," on page 21
- "vCenter Components That Require Tomcat," on page 22
- "Optional vCenter Server Components," on page 23

Components of vSphere

VMware vSphere is a suite of software components for virtualization.

To run your vSphere environment, you need the following components:

ESX/ESXi

A virtualization platform used to create the virtual machines as a set of configuration and disk files that together perform all the functions of a physical machine.

Through ESX/ESXi, you run the virtual machines, install operating systems, run applications, and configure the virtual machines. Configuration includes identifying the virtual machine's resources, such as storage devices.

The server provides bootstrapping, management, and other services that manage your virtual machines.

Each ESX/ESXi host has a vSphere Client available for your management use. If your ESX/ESXi host is registered with vCenter Server, a vSphere Client that accommodates vCenter Server features is available.

vCenter Server

A service that acts as a central administrator for VMware ESX/ESXi hosts that are connected on a network. vCenter Server directs actions on the virtual machines and the virtual machine hosts (the ESX/ESXi hosts).

vCenter Server is a single Windows Service and is installed to run automatically. vCenter Server runs continuously in the background, performing its monitoring and managing activities even when no vSphere Clients are connected and even if nobody is logged on to the computer where it resides. It must have network access to all the hosts it manages and be available for network access from any machine where the vSphere Client is run.

vCenter Server can be installed in a Windows virtual machine on an ESX/ESXi host, allowing it to take advantage of the high-availability afforded by VMware HA. See the *Installation Guide* for details on setting up this configuration.

Multiple vCenter Server systems can be joined together using Linked Mode to allow them to be managed using a single vSphere Client connection.

vCenter Server plug-ins

Applications that provide additional features and functionality to vCenter Server. Typically, plug-ins consist of a server component and a client component. After the plug-in server is installed, it is registered with vCenter Server and the plug-in client is available to vSphere clients for download. After a plug-in is installed on a vSphere client, it might alter the interface by adding views, tabs, toolbar buttons, or menu options related to the added functionality.

Plug-ins leverage core vCenter Server capabilities, such as authentication and permission management, but can have their own types of events, tasks, metadata, and privileges.

In addition to plug-ins that are available independently of vCenter Server, some vCenter Server features are implemented as plug-ins, and can be managed using the vSphere Client Plug-in Manager. These features include vCenter Storage Monitoring, vCenter Hardware Status, and vCenter Service Status.

vCenter Server database

A persistent storage area for maintaining status of each virtual machine, host, and user managed in the vCenter Server environment. The vCenter Server database can be remote or local to the vCenter Server system.

The database is installed and configured during vCenter Server installation.

If you are accessing your ESX/ESXi host directly through a vSphere Client, and not through a vCenter Server system and associated vSphere Client, you do not use a vCenter Server database.

Datastore

A virtual representation of combinations of underlying physical storage resources in the datacenter. A datastore is the storage location for virtual machine files. These physical storage resources can come from the local SCSI disk of the server, the Fibre Channel SAN disk arrays, the iSCSI SAN disk arrays, or Network Attached Storage (NAS) arrays. Datastores hide the idiosyncrasies of the storage options and provide a uniform model for various storage products required by virtual machines.

vCenter Server agent

On each managed host, software that collects, communicates, and executes the actions received from vCenter Server. The vCenter Server agent is installed the first time any host is added to the vCenter Server inventory.

Host agent On each managed host, software that collects, communicates, and executes the actions received through the vSphere Client. It is installed as part of the ESX/ESXi installation.

LDAP vCenter Server uses LDAP (Lightweight Directory Access Protocol) to synchronize data such as license and role information across vCenter Server systems joined in Linked Mode.

vSphere Client Interfaces

There are several ways to access vSphere components.

vSphere interface options include:

vSphere Client A required component and the primary interface for creating, managing, and monitoring virtual machines, their resources, and their hosts. It also provides console access to virtual machines.

vSphere Client is installed on a Windows machine with network access to your ESX/ESXi or vCenter Server system installation. The interface displays slightly different options depending on which type of server you are connected to. While all vCenter Server activities are performed by a vCenter Server system, you must use the vSphere Client to monitor, manage, and control the server. A single vCenter Server system or ESX/ESXi host can support multiple, simultaneously connected vSphere Clients.

vSphere Web Access A Web interface through which you can perform basic virtual machine management and configuration and get console access to virtual machines. It is installed with your ESX/ESXi host. Similar to the vSphere Client, vSphere Web Access works directly with a host or through vCenter Server. See the *vSphere Web Access Administrator's Guide* for additional information.

VMware Service Console A command-line interface for configuring an ESX host. For an ESXi host, use the vSphere Command-Line Interface.

vSphere Command-Line Interface A command-line interface for configuring an ESXi host. The vSphere Command-Line Interface can also be used to perform Storage VMotion operations on both ESX/ESXi hosts.

Functional Components

Functional components are used to monitor and manage your vSphere infrastructure.

The functional components are accessible from the vSphere Client Home page. Functional components are divided into four categories: Inventory, Administration, Management, and Solutions and Applications.

Inventory

You use the Inventory functional components to view the objects managed by vCenter Server. Managed objects include datacenters, resource pools, clusters, networks, datastores, templates, hosts, and virtual machines. The inventory options are:

Search Allows you to search the vSphere inventory for hosts, virtual machines, networks, datastores, and folders matching specified criteria.

Hosts and Clusters Provides a hierarchical view of hosts, clusters, and their child objects.

VMs and Templates	Provides a view of all virtual machines and templates in the inventory, grouped by datacenters and folders.
Datastores	Provides a view of all datastores in the inventory, grouped by datacenters and folders.
Networks	Provides a view of all networks in the inventory, grouped by datacenters and folders.

Administration

You use the Administration functional components to configure and monitor the state of your hosts or vCenter Server systems. The options are:

Roles	Allows you to view and create roles used to grant access privileges to users.
Sessions	Allows you to view all vSphere Client sessions currently connected to the selected vCenter Server system. If you have sufficient privileges, you can terminate sessions. Sessions are available through vCenter Server only.
Licensing	Allows you to view and administer vSphere licenses. This is available through vCenter Server only. To administer licenses for a standalone host, use the host **Configuration** tab.
System Logs	Allows you to display and export log files.
vCenter Server Settings	Allows you to configure a number of settings for the selected vCenter Server system. The vCenter Server settings are available through vCenter Server only.
vCenter Server Status	Provides a list of vSphere services with their current status. The status details include warning and alert information.
Guided Consolidation	Analyzes computers in your enterprise and recommends the best candidates to virtualize. The consolidation interface guides you through the conversion process based on the computers you select for consolidation.

Management

You use the Management functional components to monitor and manage the objects in the vSphere inventory. Management functional components are available through vCenter Server only. The options are:

Scheduled Tasks	Provides a list of activities and a means to schedule those activities. Scheduled tasks are available through vCenter Server only.
Events	Provides a list of all the events that occur in the vCenter Server environment. Use this option to view all events. To see only events relevant to a particular object, use the **Tasks & Events** tab for that object. Events are available through vCenter Server only.
Maps	Provides a visual representation of the status and structure of the vSphere environment and the relationships between managed objects. This includes hosts, networks, virtual machines, and datastores. Maps are available only through vCenter Server.
Host Profiles	Allows you to view, create, apply, and check compliance for host profiles.
Customization Specifications Manager	Allows you to create new virtual machine guest operating system specifications and manage existing specifications.

Solutions and Applications

You use the **Solutions and Applications** panel to access vCenter Server extensions installed in your vCenter Server System. For example, you can access the VMware vCenter Guided Consolidation extension and the VMware vCenter Update Manager from this panel.

NOTE This panel appears only if you purchased and installed VMware vSphere extensions that are sold separately from the VMware vCenter Server product.

Managed Components

Managed components are objects in your virtual and physical infrastructure on which you can place permissions, monitor tasks and events, and set alarms. You can group most managed components by using folders to more easily manage them.

All managed components, with the exception of hosts, can be renamed to represent their purposes. For example, they can be named after company departments or locations or functions. vCenter Server monitors and manages the following components of your virtual and physical infrastructure:

Clusters

A collection of ESX/ESXi hosts and associated virtual machines intended to work together as a unit. When you add a host to a cluster, the host's resources become part of the cluster's resources. The cluster manages the resources of all hosts.

If you enable VMware DRS on a cluster, the resources of the hosts in the cluster are merged to allow resource balancing for the hosts in the cluster. If you enable VMware HA on a cluster, the resources of the cluster are managed as a pool of capacity to allow rapid recovery from host hardware failures.See the *Resource Management Guide*.

Datacenters

Unlike a folder, which is used to organize a specific object type, a datacenter is an aggregation of all the different types of objects needed to do work in virtual infrastructure: hosts, virtual machines, networks, and datastores.

Within a datacenter there are four separate hierarchies.

- Virtual machines (and templates)
- Hosts (and clusters)
- Networks
- Datastores

The datacenter is the unit of virtualization (the namespace) of networks and datastores. Within a datacenter, you cannot have two objects (for example, two hosts) with the same name but you can have two objects with the same name in different datacenters. Virtual machine names need not be unique within the datacenter, but must be unique within each virtual machine folder.

If two virtual machines connect to networkA, they are connected to the same network. Rules are different across datacenters. Theoretically, the same physical network can appear in two datacenters and be called two different names. Or networkA might have one meaning in datacenterA and a different meaning in datacenterB. Moving objects between datacenters can create problems or, at least, unpredictable results.

To have a single namespace (that is, a single datacenter) for all networks and datastores, use folders within the datacenter to organize the networks and datastores. To have separate namespaces (separate datacenters) for networks and datastores, create two datacenters.

Datastores

A virtual representation of combinations of underlying physical storage resources in the datacenter. A datastore is the storage location for virtual machine files. These physical storage resources can come from the local SCSI disk of the server, the Fibre Channel SAN disk arrays, the iSCSI SAN disk arrays, or Network Attached Storage (NAS) arrays. Datastores hide the idiosyncrasies of the storage options and provide a uniform model for various storage products required by virtual machines.

Folders

A top-level structure for vCenter Server only. Folders allow you to group objects of the same type so you can easily manage them. For example, you can use folders to set permissions across objects, to set alarms across objects, and to organize objects in a meaningful way.

A folder can contain other folders, or a group of objects of the same type: datacenters, clusters, datastores, networks, virtual machines, templates, or hosts. For example, one folder can contain hosts and a folder containing hosts, but it cannot contain hosts and a folder containing virtual machines.

The datacenter folders form a hierarchy directly under the root vCenter Server and allow users to group their datacenters in any convenient way. Within each datacenter is one hierarchy of folders with virtual machines and templates, one with hosts and clusters, one with datastores, and one with networks.

Hosts

The physical computer on which the virtualization platform software, such as ESX/ESXi, is installed and all virtual machines reside. If the vSphere Client is connected directly to an ESX/ESXi host, only that host is available for management.

NOTE When vCenter Server refers to a host, this means the physical machine on which the virtual machines are running. All virtual machines within the VMware vSphere environment are physically on ESX/ESXi hosts. The term host in this Help system refers to the ESX/ESXi host that has virtual machines on it.

Networks

A set of virtual network interface cards (virtual NIC), virtual switches (vSwitch), and port groups that connect virtual machines to each other or to the physical network outside of the virtual datacenter. All virtual machines that connect to the same port group belong to the same network in the virtual environment, even if they are on different physical servers. You can monitor networks and set permissions and alarms on port groups.

Resource pools

A structure that allows delegation of control over the resources of a host. Resource pools are used to compartmentalize all resources in a cluster. You can create multiple resource pools as direct children of a host or cluster and configure them. Then delegate control over them to other individuals or organizations. The managed resources are CPU and memory from a host or cluster. Virtual machines execute in, and draw their resources from, resource pools.

vCenter Server provides, through the DRS components, various options in monitoring the status of the resources and adjusting or suggesting adjustments to the virtual machines using the resources. You can monitor resources and set alarms on them.

Templates	A master copy of a virtual machine that can be used to create and provision new virtual machines.
Virtual machines	A virtualized x86 or x64 personal computer environment in which a guest operating system and associated application software can run. Multiple virtual machines can operate on the same managed host machine concurrently.
vApps	VMware vApp is a format for packaging and managing applications. A vApp can contain multiple virtual machines.

Access Privileges Components

vSphere provides access control to managed objects by using user and group permissions and roles.

Each user logs in to a vCenter Server system through the vSphere Client. Each user is identified to the server as someone who has rights and privileges to selected objects, such as datacenters and virtual machines, within the vSphere environment. The vCenter Server system has full rights and privileges on all hosts and virtual machines within the vSphere environment. The server passes on only those actions and requests from a user that the user has permission to perform. Access privileges affect which vSphere Client objects appear in the inventory.

The server determines which access privileges and requests to allow based on the role assigned to the user or the user's group on each object. vCenter Server administrators can create custom roles with specific sets of privileges, as well as use the sample roles that vCenter Server provides.

Users and Groups	Created through the Windows domain or Active Directory database or on the ESX/ESXi host. The server, vCenter Server or ESX/ESXi, registers users and groups as part of the assigning privileges process.
Roles	A set of access rights and privileges. Selected sample roles exist. You can also create roles and assign combinations of privileges to each role.
Permissions	A permission consists of a user or group and a role assigned to a particular inventory object.

vCenter Server Plug-Ins

vCenter Server plug-ins extend the capabilities of vCenter Server by providing additional features and functionality.

Some plug-ins are installed as part of the base vCenter Server product.

vCenter Storage Monitoring	Allows you to review information on storage usage and visually map relationships between all storage entities available in vCenter Server.
vCenter Hardware Status	Uses CIM monitoring to display the hardware status of hosts managed by vCenter Server.
vCenter Service Status	Displays the status of vCenter services.

Some plug-ins are packaged separately from the base product and require separate installation. Plug-ins and the base product can be upgraded independently of each other. VMware modules include:

VMware Update Manager	Enables administrators to apply updates and patches across ESX/ESXi hosts and all managed virtual machines. This module provides the ability to create user-defined security baselines which represent a set of security standards. Security administrators can compare hosts and virtual machines against these baselines to identify and remediate systems that are not in compliance.
VMware Converter Enterprise for vCenter Server	Enables users to convert physical machines, and virtual machines in a variety of formats, to ESX/ESXi virtual machines. Converted systems can be imported into the vCenter Server inventory.
vShield Zones	vShield Zones is an application-aware firewall built for VMware vCenter Server integration. vShield Zones inspects client-server communications and inter-virtual-machine communication to provide detailed traffic analytics and application-aware firewall partitioning. vShield Zones is a critical security component for protecting virtualized datacenters from network-based attacks and misuse.
VMware vCenter Orchestrator	VMware vCenter Orchestrator is a workflow engine that enables you to create and execute automated workflows within your VMware vSphere environment. vCenter Orchestrator coordinates workflow tasks across multiple VMware products and third-party management and administration solutions through its open plug-in architecture. vCenter Orchestrator provides a library of workflows that are highly extensible; any operation available in the vCenter Server API can be used to customize vCenter Orchestrator workflows.
VMware Data Recovery	VMware Data Recovery is a disk-based backup and recovery solution that provides complete data protection for virtual machines. VMware Data Recovery is fully integrated with VMware vCenter Server to enable centralized and efficient management of backup jobs and includes data de-duplication to minimize disk usage.

vCenter Components That Require Tomcat

Several vCenter Server components require the Tomcat Web server to be running on the vCenter Server system. The Tomcat Web server is installed as part of the vCenter Server installation.

The components that require Tomcat to be running include the following.

- Linked Mode
- CIM/Hardware Status tab
- Performance charts
- WebAccess
- vCenter Storage Monitoring/Storage Views tab
- vCenter Service Status

Optional vCenter Server Components

Optional vCenter Server components are packaged and installed with the base product, but require a separate license.

Optional features include:

VMotion

A feature that enables you to move running virtual machines from one ESX/ESXi host to another without service interruption. It requires licensing on both the source and target host. vCenter Server centrally coordinates all VMotion activities.

VMware HA

A feature that enables a cluster with High Availability. If a host goes down, all virtual machines that were running on the host are promptly restarted on different hosts in the same cluster.

When you enable the cluster for HA, you specify the number of hosts you would like to be able to recover. If you specify the number of host failures allowed as **1**, HA maintains enough capacity across the cluster to tolerate the failure of one host. All running virtual machines on that host can be restarted on remaining hosts. By default, you cannot power on a virtual machine if doing so violates required failover capacity. See the *VMware Availability Guide* for more information.

VMware DRS

A feature that helps improve resource allocation and power consumption across all hosts and resource pools. VMware DRS collects resource usage information for all hosts and virtual machines in the cluster and gives recommendations (or migrates virtual machines) in one of two situations:

- Initial placement – When you first power on a virtual machine in the cluster, DRS either places the virtual machine or makes a recommendation.
- Load balancing – DRS tries to improve resource utilization across the cluster by performing automatic migrations of virtual machines (VMotion) or by providing a recommendation for virtual machine migrations.

VMware DRS includes distributed power management (DPM) capabilities. When DPM is enabled, the system compares cluster- and host-level capacity to the demands of virtual machines running in the cluster. Based on the results of the comparison, DPM recommends (or automatically implements) actions that can reduce the power consumption of the cluster.

vSphere SDK package

APIs for managing virtual infrastructure and documentation describing those APIs. The SDK also includes the vCenter Server Web Service interface, Web Services Description Language (WSDL), and example files. This is available through an external link. You can download the SDK package from the VMware APIs and SDKs Documentation page on the VMware Web site.

VMware Data Recovery

VMware Data Recovery is a disk-based backup and recovery solution that provides complete data protection for virtual machines. VMware Data Recovery is fully integrated with VMware vCenter Server to enable centralized and efficient management of backup jobs and includes data de-duplication to minimize disk usage.

Starting and Stopping the vSphere Components 2

You can start and stop each one of the major vSphere components, ESX/ESXi, and vCenter Server. You might want to stop a component to perform maintenance or upgrade operations.

This chapter includes the following topics:

- "Start an ESX/ESXi Host," on page 25
- "Reboot or Shut Down an ESX/ESXi Host," on page 25
- "Stop an ESX Host Manually," on page 26
- "Starting vCenter Server," on page 26
- "Start the vSphere Client and Log In," on page 27
- "Stop the vSphere Client and Log Out," on page 28
- "vSphere Web Access," on page 28
- "VMware Service Console," on page 29

Start an ESX/ESXi Host

When you install ESX/ESXi, it starts itself through the installation reboot process. If your ESX/ESXi host is shut down, you must manually restart it.

Procedure

- On the physical box where ESX/ESXi is installed, press the power button until the power on sequence begins.

  The ESX/ESXi host starts, locates its virtual machines, and proceeds with its normal ESX/ESXi functions.

Reboot or Shut Down an ESX/ESXi Host

You can power off or restart (reboot) any ESX/ESXi host using the vSphere Client. You can also power off ESX hosts from the service console. Powering off a managed host disconnects it from vCenter Server, but does not remove it from the inventory.

Procedure

1. Shut down all virtual machines running on the ESX/ESXi host.
2. Select the ESX/ESXi host you want to shut down.

3 From the main or right-click menu, select **Reboot** or **Shut Down**.

- If you select **Reboot**, the ESX/ESXi host shuts down and reboots.
- If you select **Shut Down**, the ESX/ESXi host shuts down. You must manually power the system back on.

4 Provide a reason for the shut down.

This information is added to the log.

Stop an ESX Host Manually

You can manually shut down an ESX host.

Procedure

1 Log in to the ESX service console.

2 Run the shutdown command.

For example:`shutdown –h now`

ESX shuts down. When it is finished, a message indicates that it is safe to power off your system.

3 Press the power button until the machine powers off.

For information about accessing the service console, see "Connect to the Service Console," on page 29.

Starting vCenter Server

vCenter Server runs as a Windows service. vCenter Server starts when you start the Windows machine on which it is installed. It also restarts when that machine is rebooted.

Verify That vCenter Server Is Running

You can verify that the vCenter Server service is running.

Procedure

1 Go to the Services console for your version of Windows.

For example, select **Control Panel > Administrative Tools > Services** and click **VMware VirtualCenter Server**.

The Status column indicates whether the service started.

2 Right-click the vCenter Server service and select **Properties**.

3 In the VMware vCenter Server Services Properties dialog box, click the **General** tab and view the service status.

Restart the vCenter Server System

The vCenter Server service starts when the machine on which it is installed is booted. You can manually restart the vCenter Server system.

If you have manually stopped the vCenter Server service or must start it for any reason, perform the steps below.

Procedure

1 Go to the Services console for your version of Windows.

For example, select **Control Panel > Administrative Tools > Services** and click **VMware VirtualCenter Server**.

2 Right-click **VMware VirtualCenter Server**, select **Start**, and wait for startup to complete.

3 Close the Properties dialog box.

Stop the vCenter Server System

vCenter Server is a Windows service. You can use the Windows interface to select the service and stop it.

You should not have to stop the vCenter Server service. The vCenter Server should operate without interruption. Continuous operation ensures that all monitoring and task activities are performed as expected.

Procedure

1 Go to the Services console for your version of Windows.

For example, select **Start > Control Panel > Administrative Tools > Services**.

2 Click **VMware VirtualCenter Server Service**.

3 Right-click **VMware VirtualCenter Server**, select **Stop**, and wait for it to stop.

4 Close the Properties dialog box.

Start the vSphere Client and Log In

The vSphere Client is a graphical user interface to vCenter Server and to hosts.

A login screen appears when you start the vSphere Client. After you log in, the client displays the objects and functionality appropriate to the server you are accessing and the permissions available to the user you logged in as.

Procedure

1 Log in to your Windows system.

If this is the first time you are starting the vSphere Client, log in as the administrator:

- If the managed host is not a domain controller, log in as either *<local host name>**<user>* or *<user>*, where *<user>* is a member of the local Administrators group.
- If the managed host is a domain controller, you must log in as *<domain>**<user>*, where *<domain>* is the domain name for which the managed host is a controller and *<user>*is a member of that domain's Domain Administrators group. VMware does not recommend running on a domain controller .

2 Double-click a shortcut or select the vSphere Client from **Start > Programs > VMware > vSphere Client**.

3 Enter the host name or IP address of a vCenter Server system or ESX/ESXi host, depending on what you want to access.

If you are logging in to a vCenter Server system that is part of a Connected Group, logging in to that server connects you to all servers in that group.

NOTE Only previously entered server names appear in the **Server** drop-down menu.

4 Enter a user name and password.

- If you are logging in to a vCenter Server system, enter an appropriate Windows Active Directory user name and password.

  NOTE To automatically log in with your current Windows Active Directory credentials, you can select the **Use Windows session credentials**check box. If the vSphere Client gets disconnected from the vCenter Server, you are automatically logged in after reconnection if you have selected this check box.

- If you are logging in to an ESX host for the first time, enter the user name **root** and the password that you provided during ESX installation.

  If you are logging in to an ESXi host for the first time, enter the user name **root**and leave the **Password** field blank.

5 Click **Login** to continue.

You are now connected to the host or vCenter Server system.

Stop the vSphere Client and Log Out

When you no longer need to view or alter the activities that the vCenter Server system is performing, log out of the vSphere Client.

NOTE Closing a vSphere Client session does not stop the server.

Procedure

- Click the close box (**X**) , or select **File > Exit**.

The vSphere Client shuts down. The vSphere Client is logged out of the vCenter Server system. The server continues to run all its normal activities in the background. Any scheduled tasks are saved and performed by vCenter Server.

vSphere Web Access

vSphere Web Access is the Web interface through which you can manage your virtual machines. vSphere Web Access is installed when you install ESX/ESXi.

As with the vSphere Client, vSphere Web Access can either be used to connect directly to an ESX/ESXi host or to a vCenter Server system. The functionality of vSphere Web Access is a subset of vSphere Client functionality.

The vSphere Web Access console provides a remote mouse-keyboard-screen (MKS) for the virtual machines. You can interact with a guest operating system running in a virtual machine and connect remotely to the virtual machine's mouse, keyboard, and screen.

Log In to vSphere Web Access

vSphere Web Access uses a Web interface and an Internet connection to access your ESX/ESXi host or vCenter Server system.

vSphere Web Access does not have its own concept of users or permissions. Use the same login credentials you would use to log in to the vSphere Client.

Procedure

1 Launch your Web browser.

2 Enter the URL of your ESX/ESXi or vCenter Server installation:

```
https://<host or server name>/ui
```

3 Type your user name and password, and click **Log In**.

After your user name and password are authorized by vSphere Web Access, the vSphere Web Access home page appears.

Log Out of vSphere Web Access

Log out when you are finished with your vSphere Web Access activities.

Procedure

- Click the Log Out link at the top right corner of every page.

Remote client devices are disconnected when you log out of vSphere Web Access.

VMware Service Console

In previous versions of ESX, the service console was one of the interfaces to ESX hosts. Many of the commands are now deprecated. The service console is typically used only in conjunction with a VMware technical support representative.

ESXi does not have a service console. Some service console commands are available for ESXi through the remote command-line interface.

The vSphere SDK is used for scripted manipulation of your vSphere instead. The vSphere Client is the primary interface to all nonscripted activities, including configuring, monitoring, and managing your virtual machines and resources.

Using DHCP for the Service Console

The recommended setup is to use static IP addresses for the service console of an ESX host. You can set up the service console to use DHCP, if your DNS server is capable of mapping the service console's host name to the dynamically generated IP address.

If your DNS server cannot map the host's name to its DHCP-generated IP address, you must determine the service console's numeric IP address. Another caution against using DHCP is that the numeric IP address might change as DHCP leases run out or when the system is rebooted.

VMware does not recommend using DHCP for the service console unless your DNS server can handle the host name translation.

CAUTION Do not use dynamic (DHCP) addressing when sharing the network adapter assigned to the service console with virtual machines. ESX requires a static IP address for the service console when sharing a network adapter.

Connect to the Service Console

If you have direct access to the system where ESX is running, you can log in to the physical console on that system.

Whether you use the service console locally or through a remote connection, you must log in using a valid user name and password.

NOTE Depending on the security settings for your ESX computer, you might be able to connect remotely to the service console using SSH or Telnet. For more information on the security settings, see the *ESX Configuration Guide*.

Procedure

- Press Alt+F2 to get to the login screen and log in.

Using Commands on the Service Console

The service console runs a modified version of Linux, and many of the commands available on Linux or UNIX are also available on the service console.

Detailed usage notes for most service console commands are available as manual or `man` pages.

NOTE ESXi does not have a service console. However, many of the functions provided by the service console are available through the vSphere CLI.

View the man Page for a Service Console Command

`man` pages provide information about commands, their usage, options, and syntax.

Procedure

- At the service console command line, type the `man` command followed by the name of the command for which you want to see information.

  For example: `man` *<command>*

Using vCenter Server in Linked Mode 3

You can join multiple vCenter Server systems using vCenter Linked Mode to allow them to share information. When a server is connected to other vCenter Server systems using Linked Mode, you can connect to that vCenter Server system and view and manage the inventories of all the vCenter Server systems that are linked.

Linked Mode uses Microsoft Active Directory Application Mode (ADAM) to store and synchronize data across multiple vCenter Server systems. ADAM is installed automatically as part of vCenter Server installation. Each ADAM instance stores data from all of the vCenter Server systems in the group, including information about roles and licenses. This information is regularly replicated across all of the ADAM instances in the connected group to keep them in sync.

When vCenter Server systems are connected in Linked Mode, you can:

- Log in simultaneously to all vCenter Server systems for which you have valid credentials.
- Search the inventories of all the vCenter Server systems in the group.
- View the inventories off all of the vCenter Server systems in the group in a single inventory view.

You cannot migrate hosts or virtual machines between vCenter Server systems connected in Linked Mode.

For additional information on troubleshooting Linked Mode groups, see *ESX and vCenter Server Installation Guide*.

This chapter includes the following topics:

- "Linked Mode Prerequisites," on page 31
- "Linked Mode Considerations," on page 32
- "Join a Linked Mode Group After Installation," on page 32
- "Reconciling Roles When Connecting vCenter Server to a Linked Mode Group," on page 33
- "Isolate a vCenter Server Instance from a Linked Mode Group," on page 34
- "Change the Domain of a vCenter Server System in a Linked Mode Group," on page 34
- "Configure the URLs on a Linked Mode vCenter Server System," on page 34
- "Linked Mode Troubleshooting," on page 35
- "Monitor vCenter Server Services," on page 37

Linked Mode Prerequisites

Prepare the system for joining a Linked Mode group.

All the requirements for standalone vCenter Server systems apply to Linked Mode systems. For more information, see *ESX and vCenter Server Installation Guide*.

The following requirements apply to each vCenter Server system that is a member of a Linked Mode group:

- DNS must be operational for Linked Mode replication to work.
- The vCenter Server instances in a Linked Mode group can be in different domains if the domains have a two-way trust relationship. Each domain must trust the other domains on which vCenter Server instances are installed.
- When adding a vCenter Server instance to a Linked Mode group, the installer must be run by a domain user who is an administrator on both the machine where vCenter Server is installed and the target machine of the Linked Mode group.
- All vCenter Server instances must have network time synchronization. The vCenter Server installer validates that the machine clocks are not more than 5 minutes apart.

Linked Mode Considerations

There are several considerations to take into account before you configure a Linked Mode group.

- Each vCenter Server user sees the vCenter Server instances on which they have valid permissions.
- When first setting up your vCenter Server Linked Mode group, you must install the first vCenter Server as a standalone instance because you do not yet have a remote vCenter Server machine to join. Subsequent vCenter Server instances can join the first vCenter Server or other vCenter Server instances that have joined the Linked Mode group.
- If you are joining a vCenter Server to a standalone instance that is not part of a domain, you must add the standalone instance to a domain and add a domain user as an administrator.
- The vCenter Server instances in a Linked Mode group do not need to have the same domain user login. The instances can run under different domain accounts. By default, they run as the LocalSystem account of the machine on which they are running, which means they are different accounts.
- During vCenter Server installation, if you enter an IP address for the remote instance of vCenter Server, the installer converts it into a fully qualified domain name.
- You cannot join a Linked Mode group during the upgrade procedure when you are upgrading from VirtualCenter 2.x to vCenter Server 4.0. You can join after the upgrade to vCenter Server is complete. See the *Upgrade Guide*.

Join a Linked Mode Group After Installation

If you have a system that is already running vCenter Server 4.0, you can join the machine to a Linked Mode group.

Prerequisites

See "Linked Mode Prerequisites," on page 31 and "Linked Mode Considerations," on page 32.

Procedure

1. Select **Start > All Programs > VMware > vCenter Server Linked Mode Configuration**.
2. Click **Next**.
3. Select **Modify linked mode configuration** and click **Next**.
4. Click **Join this vCenter Server instance to an existing linked mode group or another instance** and click **Next**.
5. Enter the server name and LDAP port number of a remote vCenter Server instance that is a member of the group and click **Next**.

   If you enter an IP address for the remote server, the installer converts it into a fully qualified domain name.

6 If the vCenter Server installer detects a role conflict, select how to resolve the conflict.

Option	Description
Yes, let VMware vCenter Server resolve the conflicts for me	Click **Next**. The role on the joining system is renamed to <*vcenter_name*> <*role_name*>, where <*vcenter_name*> is the name of the vCenter Server system that is joining the Linked Mode group, and <*role_name*> is the name of the original role.
No, I'll resolve the conflicts myself	To resolve the conflicts manually: a Using the vSphere Client, log in to one of the vCenter Server systems using an account with **Administrator** privileges. b Rename the conflicting role. c Close the vSphere Client session and return to the vCenter Server installer. d Click **Back** and click **Next**. The installation continues without conflicts.

A conflict results if the joining system and the Linked Mode group each contain a role with the same name but with different privileges.

7 Click **Finish**.

vCenter Server restarts. Depending on the size of your inventory, the change to Linked Mode might take from a few seconds to a few minutes to complete.

The vCenter Server instance is now part of a Linked Mode group. After you form a Linked Mode group, you can log in to any single instance of vCenter Server and view and manage the inventories of all the vCenter Servers in the group. It might take several seconds for the global data (such as user roles) that are changed on one machine to be visible on the other machines. The delay is usually 15 seconds or less. It might take a few minutes for a new vCenter Server instance to be recognized and published by the existing instances, because group members do not read the global data very often.

Reconciling Roles When Connecting vCenter Server to a Linked Mode Group

When you join a vCenter Server system to a linked mode group, the roles defined on each vCenter Server system in the group are replicated to the other systems in the group.

If the roles defined on each vCenter Server system are different, the roles lists of the systems are combined into a single common list. For example, if vCenter Server 1 has a role named Role A and vCenter Server 2 has a role named Role B, then both servers will have both Role A and Role B after they are joined in a linked mode group.

If two vCenter Server systems have roles with the same name, the roles are combined into a single role if they contain the same privileges on each vCenter Server system. If two vCenter Server systems have roles with the same name that contain different privileges, this conflict must be resolved by renaming at least one of the roles. You can choose to resolve the conflicting roles either automatically or manually.

If you choose to reconcile the roles automatically, the role on the joining system is renamed to <*vcenter_name*> <*role_name*> where <*vcenter_name*> is the name of the vCenter Server system that is joining the Linked Mode group and <*role_name*> is the name of the original role.

If you choose to reconcile the roles manually, connect to one of the vCenter Server systems with the vSphere Client and rename one instance of the role before proceeding to join the vCenter Server system to the Linked Mode group.

If you remove a vCenter Server system from a linked mode group, the vCenter Server system retains all the roles it had as part of the group.

Isolate a vCenter Server Instance from a Linked Mode Group

You can isolate a vCenter Server instance from a Linked Mode group.

Procedure

1 Select **Start > All Programs > VMware > vCenter Server Linked Mode Configuration**.

2 Click **Modify linked mode configuration** and click **Next**.

3 Click **Isolate this vCenter Server instance from linked mode group** and click **Next**.

4 Click **Continue** and click **Finish**.

vCenter Server restarts. Depending on the size of your inventory, the change to Linked Mode might take from a few seconds to a few minutes to complete.

The vCenter Server instance is no longer part of the Linked Mode group.

Change the Domain of a vCenter Server System in a Linked Mode Group

To change the domain of a vCenter Server system in a Linked Mode group, isolate the vCenter Server system from the Linked Mode group first.

vCenter Server systems in a Linked Mode group can be in different domains as long as the domains have a trust relationship.

Procedure

1 Isolate the vCenter Server system from the Linked Mode group.

2 Change the domain of the vCenter Server system.

Refer to Microsoft documentation for more information on changing the domain.

3 Rejoin the vCenter Server system to the Linked Mode group.

Configure the URLs on a Linked Mode vCenter Server System

If you connect a vCenter Server system to a Linked Mode group and the vCenter Server system has a machine name that does not match the domain name, several connectivity problems arise. This procedure describes how to correct this situation.

If you do not update the URLs, remote instances of vCenter Server cannot reach the vCenter Server system, because the default vCenter Server URL entries are no longer accurate. The vCenter Server installer configures default URL entries as follows:

- For the Virtualcenter.VimApiUrl key, the default value is `http(s)://<Fully qualified domain name (FQDN) of VC machine>/sdk`.
- For the Virtualcenter.VimWebServicesUrl key, the default value is `https://<FQDN of VC machine>:<installed-webservices-port>/vws`.

Procedure

1 Isolate the vCenter Server system from the Linked Mode group.

See "Isolate a vCenter Server Instance from a Linked Mode Group," on page 34.

2 Change the domain name or the machine name to make them match.

3 From the vSphere Client, connect directly to the vCenter Server instance on which you have changed the domain or machine name.

4 Select **Administration > vCenter Server Settings** and click **Advanced Settings**.

5 For the Virtualcenter.VimApiUrl key, change the value to point to the location where the vSphere Client and SDK clients can access the vCenter Server system.

For example: `http(s)://<machine-name/ip>:<vc-port>/sdk`.

6 For the Virtualcenter.VimWebServicesUrl key, change the value to point to the location where vCenter Server Webservices is installed.

For example: `https://<machine-name/ip>:<webservices-port>/vws`.

7 For the Virtualcenter.Instancename key, change the value so that the modified name appears in the vCenter Server inventory view.

8 Rejoin the vCenter Server system to the Linked Mode group.

See "Join a Linked Mode Group After Installation," on page 32.

Linked Mode Troubleshooting

If you are having trouble with your Linked Mode group, consider the following points.

- When you have multiple vCenter Server instances, each instance must have a working relationship with the domain controller and not conflict with another machine that is in the domain. Conflicts can occur, for example, when you clone a vCenter Server instance that is running in a virtual machine and you do not use sysprep or a similar utility to ensure that the cloned vCenter Server instance has a globally unique identifier (GUID).
- If the domain controller is unreachable, vCenter Server might be unable to start. You might be unable to make changes to the Linked Mode configuration of the affected vCenter Server system.

  If this occurs, resolve the problem with the domain controller and restart vCenter Server. If resolving the problem with the domain controller is not possible, you can restart vCenter Server by removing the vCenter Server system from the domain and isolating the system from its current Linked Mode group.
- The DNS name of the machine must match with the actual machine name. Symptoms of machine names not matching the DNS name are data replication issues, ticket errors when trying to search, and missing search results from remote instances.
- There is correct order of operations for joining a Linked Mode group.

  a Verify that the vCenter Server domain name matches the machine name. If they do not match, change one or both to make them match.

  b Update the URLs to make them compatible with the new domain name and machine name.

  c Join the vCenter Server system to a Linked Mode group.

  If you do not update the URLs, remote instances of vCenter Server cannot reach the vCenter Server system, because the default vCenter Server URL entries are no longer accurate. See "Configure the URLs on a Linked Mode vCenter Server System," on page 34.

  If a vCenter Server instance is no longer reachable by remote instances of vCenter Server, the following symptom might occur:

  - Clients logging in to other vCenter Server systems in the group cannot view the information that belongs to the vCenter Server system on which you changed the domain name because the users cannot log in to the system.
  - Any users that are currently logged in to the vCenter Server system might be disconnected.
  - Search queries do not return results from the vCenter Server system.

To resolve this issue, make sure that the Virtualcenter.VimApiUrl key points to the location where the vSphere Client and SDK clients can access the vCenter Server system, and the Virtualcenter.VimWebServicesUrl key points to the location where vCenter Server Webservices is installed. For the Virtualcenter.Instancename key, change the value so that the modified name appears in the vCenter Server inventory view.

- If you cannot join a vCenter Server instance, you can resolve the problem with the following actions:
  - Ensure that the machine is grouped into the correct organizational unit in the corresponding domain controller.
  - When you install vCenter Server, ensure that the logged in user account has administrator privileges on the machine.
  - To resolve trust problems between a machine and the domain controller, remove the machine from the domain and then add it to the domain again.
  - To ensure that the Windows policy cache is updated, run the `gpupdate /force` command from the Windows command line. This command performs a group policy update.
- If the local host cannot reach the remote host during a join operation, verify the following:
  - Remote vCenter Server IP address or fully qualified domain name is correct.
  - LDAP port on the remote vCenter Server is correct.
  - VMwareVCMSDS service is running.
- Make sure your Windows and network-based firewalls are configured to allow Linked Mode.

Configuring a Windows Firewall to Allow a Specified Program Access

vCenter Server 4.0 uses Microsoft ADAM/AD LDS to enable Linked Mode, which uses the Windows RPC port mapper to open RPC ports for replication. When you install vCenter Server in Linked Mode, the firewall configuration on the local machine must be modified.

Incorrect configuration of firewalls can cause licenses and roles to become inconsistent between instances.

Prerequisites

- The Windows version must be an earlier than Windows Server 2008. For Windows Server 2008, Windows automatically configures the firewall to permit access.
- There must be no network-based firewalls between vCenter Server Linked Mode instances. For environments with network-based firewalls, see "Configuring Firewall Access by Opening Selected Ports," on page 37.

Procedure

1. Select **Start > Run**.
2. Type **`firewall.cpl`** and click **OK**.
3. Make sure that the firewall is set to allow exceptions.
4. Click the **Exceptions** tab.
5. Click **Add Program**.
6. Add an exception for `C:\Windows\ADAM\dsamain.exe` and click **OK**.
7. Click **OK**.

Configuring Firewall Access by Opening Selected Ports

vCenter Server 4.0 uses Microsoft ADAM/AD LDS to enable Linked Mode, which uses the Windows RPC port mapper to open RPC ports for replication. When you install vCenter Server in Linked Mode, the firewall configuration on any network-based firewalls must be modified.

Incorrect configuration of firewalls can cause licenses and roles to become inconsistent between instances.

Procedure

- Configure Windows RPC ports to generically allow selective ports for machine-to-machine RPC communication.

  Choose one of the following methods.

  - Change the registry settings. See http://support.microsoft.com/kb/154596/en-us.
  - Use Microsoft's `RPCCfg.exe` tool. See http://support.microsoft.com/kb/908472/en-us.

Monitor vCenter Server Services

When you are logged in to a vCenter Server system that is part of a connected group, you can monitor the health of services running on each server in the group.

Procedure

- From the vSphere Client Home page, click **vCenter Service Status**.

  The vCenter Service Status screen appears and enables you to view the following information:

  - A list of all vCenter Server systems and their services, and vCenter Server plug-ins.
  - The status of all listed items.
  - The date and time when the last change in status occurred.
  - Any messages associated with the change in status.

Using the vSphere Client

4

The vSphere Client serves as the principal interface for administering vCenter Server and ESX/ESXi.

The vSphere Client user interface is configured based on the server to which it is connected:

- When the server is a vCenter Server system, the vSphere Client displays all the options available to the vSphere environment, according to the licensing configuration and the user permissions.
- When the server is an ESX/ESXi host, the vSphere Client displays only the options appropriate to single host management.

When you first log in to the vSphere Client, it displays a Home page with icons that you select to access various vSphere Client functions. When you log out of the vSphere Client, the client application remembers the view that was displayed when it was closed, and will return you to that view when you next log in.

You perform many management tasks from the Inventory view, which consists of a single window containing a menu bar, a navigation bar, a toolbar, a status bar, a panel section, and pop-up menus.

This chapter includes the following topics:

- "Getting Started Tabs," on page 40
- "Status Bar, Recent Tasks, and Triggered Alarms," on page 40
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Getting Started Tabs

In the case where vCenter Server is newly installed and no inventory objects have been added, the Getting Started tabs guide you through the steps of adding items to the inventory and setting up the virtual environment.

Disable Getting Started Tabs

You can disable the Getting Started tabs if you no longer want to display them.

There are two ways to disable the tabs.

Procedure

- Click the **Close Tab** link to disable Getting Started tabs for the type of object selected.
- Change the vSphere Client settings to turn off display of all Getting Started tabs.
  a Select **Edit > Client Settings**.
  b Select the **General** tab.
  c Deselect the **Show Getting Started Tabs** check box and click **OK**.

Restore Getting Started Tabs

If you have turned off display of the Getting Started tabs, you can restore them to display these tabs for all inventory objects.

Procedure

1 Select **Edit > Client Settings**.
2 Click the **General** tab.
3 Select **Show Getting Started Tabs** and click **OK**.

Status Bar, Recent Tasks, and Triggered Alarms

Use the status bar to view information about alarms and recently completed or active tasks.

The status bar appears at the bottom of the window. It contains icons to view triggered alarms or recent tasks. The **Tasks** button displays any currently running or recently completed active tasks. Included is a progress bar indicating the percentage complete of each task. The recent tasks and the triggered alarm panels display across the bottom of the vSphere Client window.

Panel Sections

In the body of the vSphere Client page is a panel section. In most views, there is a left and a right panel: the Inventory panel and the Information panel.

These panels can be resized.

Inventory panel Displays a hierarchical list of vSphere objects when an Inventory or Maps view appears.

Information panels Display lists and charts. Depending on the navigation items or Inventory item selected, the Information panel is divided into tabbed elements.

View Virtual Machine Console

The console of a powered-on virtual machine is available through a connected server. All console connections to the virtual machine see the same display information. The message line indicates if others are viewing the virtual machine.

Procedure

1 Select a powered-on virtual machine.

2 In the Information panel, click the **Console** tab.

3 (Optional) Click the pop-out icon in the navigation bar to pop out the virtual machine console in a separate window.

4 (Optional) Press Ctrl+Alt+Enter to enter or exit full screen mode.

Searching the vSphere Inventory

The vSphere Client allows you to search your vSphere inventory for virtual machines, hosts, datastores, networks, or folders that match specified criteria.

If the vSphere Client is connected to a vCenter Server system that is part of a connected group in vCenter Linked Mode, then you can search the inventories of all vCenter Server systems in that group. You can only view and search for inventory objects that you have permission to view. Because the search service queries Active Directory for information about user permissions, you must be logged in to a domain account in order to search all vCenter Server systems in Linked Mode. If you log in using a local account, searches return results only for the local vCenter Server system, even if it is joined to other servers in Linked Mode.

NOTE If your permissions change while you are logged in, the search service might not immediately recognize these changes. To ensure that your search is carried out with up-to-date permissions, log out of all your open sessions and log in again before performing the search.

Perform a Simple Search

A simple search searches all the properties of the specified type or types of objects for the entered search term.

Procedure

1 Click the icon in the search field at the top right of the vSphere Client window and select the type of inventory item to search for.

- **Virtual Machines**
- **Folders**
- **Hosts**
- **Datastores**
- **Networks**
- **Inventory**, which finds matches to the search criteria in any of the available managed object types.

2 Type one or more search terms into the search field and press Enter.

3 (Optional) If more items are found than can be displayed in the results pane, click **Show all** to display all results.

What to do next

If you are not satisfied with the results of the simple search and want to refine your search, perform an advanced search.

Perform an Advanced Search

Using advanced search allows you to search for managed objects that meet multiple criteria.

For example, you can search for virtual machines matching a particular search string which reside on hosts whose names match a second search string.

Procedure

1 Choose **View > Inventory > Search** to display the advanced search page.

2 Click the icon in the search field at the top right of the vSphere Client window and select the type of inventory item to search for.

- **Virtual Machines**
- **Folders**
- **Hosts**
- **Datastores**
- **Networks**
- **Inventory**, which finds matches to the search criteria in any of the available managed object types.

3 Type one or more search terms into the search box.

4 To refine the search based on additional properties, do the following:

a Click **Show options**.

b From the drop-down menu, select the additional property that you want to use to restrict the search results.

The available properties depend on the type of object you are searching for.

c Select or type the appropriate options for the property you have selected.

d To add more properties, click **Add** and repeat steps Step 4b through Step 4c.

An advanced search always finds objects that match all the properties in the list.

5 Click **Search**.

The search results appear below the search specification.

Using Lists

Many vSphere Client inventory tabs display lists of information.

For example, the Virtual Machines tab displays a list of all the virtual machines associated with a host or a cluster. Sort any list in the vSphere Client by clicking the column label heading. A triangle in the column head shows the sort order as ascending or descending.

You can also filter a list, sorting and including only selected items. A filter is sorted by a keyword. Select the columns you want to include in the search for the keyword.

Filter a List View

You can filter the list view.

The list is updated based on whether filtering is on or off. For example, if you are in the **Virtual Machines** tab, you have filtered the list, and the filtered text is "powered on", you see a list only of virtual machines whose state is set to powered on. If the state of any of these virtual machines changes to something else, they are removed from the list. New virtual machines that are added are also being filtered. Filtering is persistent for the user session.

Procedure

1 On any inventory panel displaying a list, click the arrow next to the filter box at the top right of the pane and select the attributes on which to filter.

2 Type text directly into the filtering field to specify search criteria.

There is a one-second interval between keystrokes. If you type in the text and wait for one second, the search starts automatically. The Filter field does not support boolean expressions or special characters and is not case sensitive.

3 (Optional) Click **Clear** to change the filter.

Export a List

You can export a list.

Procedure

1 Select the list to export.

2 Select **File > Export > Export List**.

3 Type a filename, select a file type in the dialog box, and click **Save**.

Custom Attributes

Custom attributes can be used to associate user-specific meta-information with virtual machines and managed hosts.

Attributes are the resources that are monitored and managed for all the managed hosts and virtual machines in your vSphere environment. Attributes' status and states appear on the various Inventory panels.

After you create the attributes, set the value for the attribute on each virtual machine or managed host, as appropriate. This value is stored with vCenter Server and not with the virtual machine or managed host. Then use the new attribute to filter information about your virtual machines and managed hosts. If you no longer need the custom attribute, remove it. A custom attribute is always a string.

For example, suppose you have a set of products and you want to sort them by sales representative. Create a custom attribute for sales person name, Name. Add the custom attribute, Name, column to one of the list views. Add the appropriate name to each product entry. Click the column title Name to sort alphabetically.

The custom attributes feature is available only when connected to a vCenter Server system.

Add Custom Attributes

You can create custom attributes to associate with virtual machines or managed hosts.

Procedure

1 Select **Administration > Custom Attributes**.

This option is not available when connected only to an ESX/ESXi host.

2 Click **Add** and enter the values for the custom attribute.

a In the **Name** text box, type the name of the attribute.

b In the **Type** drop-down menu, select the attribute type:**Virtual Machine**, **Host**, or **Global**.

c In the **Value** text box, type the value you want to give to the attribute for the currently selected object.

d Click **OK**.

After you have defined an attribute on a single virtual machine or host, it is available to all objects of that type in the inventory. However, the value you specify is applied only to the currently selected object.

3 (Optional) To change the attribute name, click in the **Name** field and type the name you want to assign to the attribute.

4 Click **OK**.

Edit a Custom Attribute

You can edit custom attributes and add annotations for a virtual machine or host from the Summary tab for the object. You can use annotations to provide additional descriptive text or comments for an object.

Procedure

1 Select the virtual machine or host in the inventory.

2 Click the **Summary** tab for the virtual machine or host.

3 In the Annotations box, click the **Edit** link.

The Edit Custom Attributes dialog box appears.

4 To edit an attribute that has already been defined, double-click the **Value** field for that attribute and enter the new value.

5 Click **OK** to save your changes.

Select Objects

vCenter Server objects are datacenters, networks, datastores, resource pools, clusters, hosts, and virtual machines.

Selecting an object does the following:

- Allows you to view the status of the object.
- Enables the menus so you can select actions to take on the object.

Procedure

- Locate the object by browsing or search.
  - From the vSphere Client Home page, click the icon for the appropriate inventory view, and browse through the inventory hierarchy to select the object.
  - Perform a search for the object, and double-click it in the search results.

Manage vCenter Server Plug-Ins

After the server component of a plug-in is installed and registered with vCenter Server, its client component is available to vSphere clients. Client component installation and enablement are managed through the Plug-in Manager dialog box.

The Plug-in Manager enables users to do the following:

- View available plug-ins that are not currently installed on the client.
- View installed plug-ins.
- Download and install available plug-ins.
- Enable and disable installed plug-ins.

Install Plug-Ins

You can install plug-ins using the Plug-in Manager.

Procedure

1. Launch the vSphere Client and log in to a vCenter Server system.
2. Select **Plug-ins > Manage Plug-ins**.
3. Select the **Available** tab in the Plug-in Manager dialog box.
4. Click **Download and Install** for the plug-in you want.
5. Follow the prompts in the installation wizard.
6. After installation is complete, verify that the plug-in is listed under the **Installed** tab and that it is enabled.

Disable and Enable Plug-Ins

You can disable or enable plug-ins using the Plug-in Manager.

Procedure

1. Launch the vSphere Client and log in to a vCenter Server system.
2. Select **Plug-ins > Manage Plug-ins**.
3. Select the **Installed** tab in the Plug-in Manager dialog box.
4. Select **Enable** to enable a plug-in, or deselect **Enable** to disable it.

Disabling a plug-in does not remove it from the client. You must uninstall the plug-in to remove it.

Remove Plug-Ins

You can remove plug-ins through the operating system's control panel.

Procedure

- Consult your operating system's documentation for instructions on how to use the Add/Remove Programs control panel.

Troubleshooting Extensions

In cases were vCenter Server extensions are not working, you have several options to correct the problem.

vCenter Server extensions running on the tomcat server have `extension.xml` files which contain the URL where the corresponding Web application can be accessesed (files are located in `C:\Program Files\VMware\Infrastructure\VirtualCenter Server\extensions`). Extension installers populate these XML files using the DNS name for the machine.

Example from the stats `extension.xml` file: `<url>https://SPULOV-XP-VM12.vmware.com:8443/statsreport/vicr.do</url>`.

vCenter Server, extension servers, and the vSphere Clients that will use them must be located on systems under the same domain. If they are not, or the DNS of the extension server is changed, the extension clients will not be able to access the URL and the extension will not work.

You can edit the XML files manually by replacing the DNS name with an IP address. Re-register the extension after editing its `extension.xml` file.

Save vSphere Client Data

The vSphere Client user interface is similar to a browser. Most user manipulations are persistent in vCenter Server data displayed; therefore, you do not normally need to save the data.

If you need to save vSphere Client data, you can do one of the following:

Procedure

- Use the Microsoft Windows **Print Screen** option to print a copy of the vSphere Client window.
- Select **File > Export** and select a format in which to save the vCenter Server data. Open the data in an appropriate application and print from that application.

Configuring Hosts and vCenter Server 5

Configuring ESX hosts, vCenter Server systems, and the vSphere Client involves several tasks. This section contains information about some of the most common tasks.

For complete information about configuring ESX hosts, vCenter Server, and the vSphere Client, see the following manuals:

- *Introduction to vSphere*

  Provides an overview of the system architecture of vSphere.

- *ESX Configuration Guide*

  Provides information about how to configure ESX host networking, storage, and security.

- *ESXi Configuration Guide*

  Provides information about how to configure an ESXi host.

This chapter includes the following topics:

- "Host Configuration," on page 47
- "Configuring vCenter Server," on page 48
- "Access the vCenter Server Settings," on page 48
- "Configuring Communication Among ESX, vCenter Server, and the vSphere Client," on page 49
- "Configure vCenter Server SMTP Mail Settings," on page 49
- "Working with Active Sessions," on page 49
- "SNMP and vSphere," on page 50
- "System Log Files," on page 65

Host Configuration

Before you create virtual machines on your hosts, you must configure them to ensure that they have correct licensing, network and storage access, and security settings. Each type of host has a manual that provides information on the configuration for that host.

- For information on configuring an ESX host, see the *ESX Configuration Guide*.
- For information on configuring an ESXi host, see the *ESXi Configuration Guide*.

Configuring vCenter Server

You use the vCenter Server Settings dialog box to configure a number of elements.

The vCenter Server Settings dialog box enables you to configure the following items:

Licensing	Assign vCenter Server a new or existing license key. Specify whether to use a VMware License Server.
Statistics	Specify the amount of data collected for performance statistics.
Runtime Settings	View the unique runtime settings for a vCenter Server system. If you change the DNS name of the vCenter Server, use this option to modify the vCenter Server name to match.
Active Directory	Specify the active directory timeout, maximum number of users and groups to display in the Add Permissions dialog box, and the frequency for performing a synchronization and validation of the vCenter Server system's known users and groups.
Mail	Specify the SMTP server and mail account.
SNMP	Specify the SNMP receiver URLs, ports, and community strings.
Ports	Specify the HTTP and HTTPS ports for the Web Service to use
Timeout Settings	Specify how long, in seconds, the vSphere Client waits for a response from vCenter Server before timing out.
Logging Options	Specify the amount of detail collected in vCenter Server log files.
Database	Specify the password required to access the vCenter Server database and the maximum number of database connections to be created.
Database Retention Policy	Specify when vCenter Server tasks and events should be deleted.
SSL Settings	Specify whether you want vCenter Server and the vSphere Client to verify the SSL certificates of the remote host when establishing remote connections. The **vCenter requires verified host SSL certificates** option is enabled by default, and is required for the VMware Fault Tolerance feature to operate.
Advanced Settings	Specify advanced settings. VMware recommends that you do not change these settings without contacting VMware technical support.

See the vSphere Client online Help for more information on these settings.

Access the vCenter Server Settings

Use the vCenter Server Settings dialog box to configure server settings.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If the vCenter Server system is part of a connected group, select the server to configure from the **Current vCenter Server** drop-down menu.

Changes to the vCenter Server configuration apply to the current vCenter Server system only.

Configuring Communication Among ESX, vCenter Server, and the vSphere Client

By default, the vSphere Client uses ports 80 and 443 to communicate with vCenter Server and ESX/ESXi hosts. You can change these ports if necessary.

Configure your firewall to allow communication between the vSphere Client and vCenter Server by opening ports 80 and 443.

vCenter Server acts as a web service. If your environment requires the use of a web proxy, vCenter Server can be proxied like any other web service.

Configure vCenter Server SMTP Mail Settings

You can configure vCenter Server to send email notifications as alarm actions.

Prerequisites

Before vCenter Server can send email, you must perform the following tasks:

- Configure the SMTP server settings for vCenter Server.
- Specify email recipients through the Alarm Settings dialog box when you configure alarm actions.

To perform this task, the vSphere Client must be connected to a vCenter Server.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If the vCenter Server system is part of a connected group, in **Current vCenter Server**, select the vCenter Server system to configure.

3 Select **Mail** in the navigation list.

4 For email message notification, set the SMTP server and SMTP port:

Option	Description
SMTP Server	The DNS name or IP address of the SMTP gateway to use for sending email messages.
Sender Account	The email address of the sender, for example, notifications@example.com.

5 Click **OK**.

Working with Active Sessions

You can view a list of users who are logged in to a vCenter Server system when your vSphere Client is connected to that server. You can terminate sessions, and you can send a message to all users logged on to an active session.

These features are not available when your vSphere Client is connected to an ESX/ESXi host.

View Active Sessions

You can view active sessions on the Home page of a vSphere Client.

Procedure

- From the Home page of a vSphere Client connected to a vCenter Server system, click the **Sessions** button.

Terminate Active Sessions

Terminating an active session ends the vSphere Client session and any remote console connections launched by the user during that session.

Procedure

1 On the Home page of a vSphere Client connected to a vCenter Server system, click the **Sessions** button.

2 Right-click a session and select **Terminate**.

3 To confirm the termination, click **OK**.

Send a Message to All Active Users

You can a Message of the Day to all active session user and new users when they log into the vSphere Client.

The **Message of the day** text is sent as a notice message to all active session users and to new users when they log in.

Procedure

1 On the Home page of a vSphere Client connected to a vCenter Server system, click the **Sessions** button.

2 Type a message in the **Message of the day** field.

3 Click **Change**.

SNMP and vSphere

Simple Network Management Protocol (SNMP) allows management programs to monitor and control a variety of networked devices.

Managed systems run SNMP agents, which can provide information to a management program in at least one of the following ways:

- In response to a `GET` operation, which is a specific request for information from the management system.
- By sending a trap, which is an alert sent by the SNMP agent to notify the management system of a particular event or condition.

Management Information Base (MIB) files define the information that can be provided by managed devices. The MIB files contain object identifiers (OIDs) and variables arranged in a hierarchy.

vCenter Server and ESX/ESXi have SNMP agents. The agent provided with each product has differing capabilities.

Using SNMP Traps with vCenter Server

The SNMP agent included with vCenter Server can be used to send traps when the vCenter Server system is started and when an alarm is triggered on vCenter Server. The vCenter Server SNMP agent functions only as a trap emitter, and does not support other SNMP operations, such as `GET`.

The traps sent by vCenter Server are typically sent to other management programs. You must configure your management server to interpret the SNMP traps sent by vCenter Server.

To use the vCenter Server SNMP traps, configure the SNMP settings on vCenter Server and configure your management client software to accept the traps from vCenter Server.

The traps sent by vCenter Server are defined in `VMWARE-VC-EVENT-MIB.mib`. See "VMWARE-VC-EVENT-MIB," on page 62.

Configure SNMP Settings for vCenter Server

To use SNMP with vCenter Server, you must configure SNMP settings using the vSphere Client.

Prerequisites

To complete the following task, the vSphere Client must be connected to a vCenter Server. In addition, you need the DNS name and IP address of the SNMP receiver, the port number of the receiver, and the community identifier.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If the vCenter Server is part of a connected group, in **Current vCenter Server**, select the appropriate server.

3 Click **SNMP** in the navigation list.

4 Enter the following information for the **Primary Receiver** of the SNMP traps.

Option	Description
Receiver URL	The DNS name and IP address of the SNMP receiver.
Receiver port	The port number of the receiver to which the SNMP agent sends traps. If the port value is empty, vCenter Server uses the default port, **162**.
Community	The community identifier.

5 (Optional) Enable additional receivers in the **Enable Receiver 2**, **Enable Receiver 3**, and **Enable Receiver 4** options.

6 Click **OK**.

The vCenter Server system is now ready to send traps to the management system you have specified.

What to do next

Configure your SNMP management software to receive and interpret data from the vCenter Server SNMP agent. See "Configure SNMP Management Client Software," on page 53.

Configure SNMP for ESX/ESXi

ESX/ESXi includes an SNMP agent embedded in hostd that can both send traps and receive polling requests such as `GET` requests. This agent is referred to as the embedded SNMP agent.

Versions of ESX prior to ESX 4.0 included a Net-SNMP-based agent. You can continue to use this Net-SNMP-based agent in ESX 4.0 with MIBs supplied by your hardware vendor and other third-party management applications. However, to use the VMware MIB files, you must use the embedded SNMP agent.

By default, the embedded SNMP agent is disabled. To enable it, you must configure it using the vSphere CLI command `vicfg-snmp`. For a complete reference to `vicfg-snmp` options, see *vSphere Command-Line Interface Installation and Reference Guide*.

Prerequisites

SNMP configuration for ESX/ESXi requires the vSphere CLI. For information on installing and using the vSphere CLI, see *vSphere Command-Line Interface Installation and Reference Guide*.

Procedure

1 Configure SNMP Communities on page 52

Before you enable the ESX/ESXi embedded SNMP agent, you must configure at least one community for the agent.

2 Configure the SNMP Agent to Send Traps on page 52

You can use the ESX/ESX embedded SNMP agent to send virtual machine and environmental traps to management systems. To configure the agent to send traps, you must specify a target address and community.

3 Configure the SNMP Agent for Polling on page 53

If you configure the ESX/ESXi embedded SNMP agent for polling, it can listen for and respond to requests from SNMP management client systems, such as `GET` requests.

Configure SNMP Communities

Before you enable the ESX/ESXi embedded SNMP agent, you must configure at least one community for the agent.

An SNMP community defines a group of devices and management systems. Only devices and management systems that are members of the same community can exchange SNMP messages. A device or management system can be a member of multiple communities.

Prerequisites

SNMP configuration for ESX/ESXi requires the vSphere CLI. For information on installing and using the vSphere CLI, see *vSphere Command-Line Interface Installation and Reference Guide*.

Procedure

- From the vSphere CLI, type
  `vicfg-snmp.pl --server <hostname> --username <username> --password <password> -c <com1>`.

  Replace *<com1>* with the community name you wish to set. Each time you specify a community with this command, the setings you specify overwrite the previous configuration. To specify multiple communities, separate the community names with a comma.

  For example, to set the communities public and internal on the host host.example.com, you might type **`vicfg-snmp.pl --server host.example.com --username user --password password -c public, internal`**.

Configure the SNMP Agent to Send Traps

You can use the ESX/ESX embedded SNMP agent to send virtual machine and environmental traps to management systems. To configure the agent to send traps, you must specify a target address and community.

To send traps with the SNMP agent, you must configure the target (receiver) address, community, and an optional port. If you do not specify a port, the SNMP agent sends traps to UDP port 162 on the target management system by default.

Prerequisites

SNMP configuration for ESX/ESXi requires the vSphere CLI. For information on installing and using the vSphere CLI, see *vSphere Command-Line Interface Installation and Reference Guide*.

Procedure

1 From the vSphere CLI, type
vicfg-snmp.pl --server *<hostname>* --username *<username>* --password *<password>* -t *<target address>*@*<port>*/*<community>*.

Replace <target address>, <port>, and <community> with the address of the target system, the port number to send the traps to, and the community name, respectively. Each time you specify a target with this command, the settings you specify overwrite all previously specified settings. To specify multiple targets, separate them with a comma.

For example, to send SNMP traps from the host host.example.com to port 162 on target.example.com using the public community, type
vicfg-snmp.pl --server host.example.com --username user --password password -t target.example.com@162/public.

2 (Optional) Enable the SNMP agent by typing
vicfg-snmp.pl --server *<hostname>* --username *<username>* --password *<password>* --enable.

3 (Optional) Send a test trap to verify that the agent is configured correctly by typing
vicfg-snmp.pl --server *<hostname>* --username *<username>* --password *<password>* --test.

The agent sends a `warmStart` trap to the configured target.

Configure the SNMP Agent for Polling

If you configure the ESX/ESXi embedded SNMP agent for polling, it can listen for and respond to requests from SNMP management client systems, such as `GET` requests.

By default, the embedded SNMP agent listens on UDP port 161 for polling requests from management systems. You can use the `vicfg-snmp` command to configure an alternative port. To avoid conflicting with other services, use a UDP port that is not defined in `/etc/services`.

IMPORTANT Both the embedded SNMP agent and the Net-SNMP-based agent available in the ESX service console listen on UDP port 161 by default. If you enable both of these agents for polling on an ESX host, you must change the port used by at least one of them.

Prerequisites

SNMP configuration for ESX/ESXi requires the vSphere CLI. For information on installing and using the vSphere CLI, see *vSphere Command-Line Interface Installation and Reference Guide*.

Procedure

1 From the vSphere CLI, type
vicfg-snmp.pl --server *<hostname>* --username *<username>* --password *<password>* -p *<port>*.

Replace *<port>* with the port for the embedded SNMP agent to use for listening for polling requests.

2 (Optional) If the SNMP agent is not enabled, enable it by typing
vicfg-snmp.pl --server *<hostname>* --username *<username>* --password *<password>* --enable.

Configure SNMP Management Client Software

After you have configured a vCenter Server system or an ESX/ESXi host to send traps, you must configure your management client software to receive and interpret those traps.

To configure your management client software, you must specify the communities for the managed device, configure the port settings, and load the VMware MIB files. Refer to the documentation for your management system for specific instructions for these steps.

Prerequisites

To complete this task, you must download the VMware MIB files from the VMware website: http://communities.vmware.com/community/developer/managementapi.

Procedure

1 In your management software, specify the vCenter Server or ESX/ESXi system as an SNMP-based managed device.

2 Set up appropriate community names in the management software.

These must correspond to the communities set for the SNMP agent on the vCenter Server system or ESX/ESXi host.

3 (Optional) If you configured the SNMP agent to send traps to a port on the management system other than the default UDP port 162, configure the management client software to listen on the port you configured.

4 Load the VMware MIBs into the management software so you can view the symbolic names for the vCenter Server or ESX/ESXi variables.

To prevent lookup errors, load the MIB files in the following order:

a `VMWARE-ROOT-MIB.mib`

b `VMWARE-TC-MIB.mib`

c `VMWARE-PRODUCTS-MIB.mib`

d `VMWARE-SYSTEM-MIB.mib`

e `VMWARE-ENV-MIB.mib`

f `VMWARE-RESOURCES-MIB.mib`

g `VMWARE-VMINFO-MIB.mib`

h `VMWARE-OBSOLETE-MIB.mib` (for use with versions of ESX/ESXi prior to 4.0)

i `VMWARE-AGENTCAP-MIB.mib`

j `VMWARE-VC-EVENT-MIB.mib`

The management software can now receive and interpret traps from vCenter Server or ESX/ESXi systems.

SNMP Diagnostics

Use SNMP tools to diagnose configuration problems.

You can use the following tools to diagnose problems with SNMP configuration:

- Type **`vicfg-snmp.pl --server <hostname> --username <username> --password <password> --test`** at the vSphere command-line interface to prompt the embedded SNMP agent to send a test `warmStart` trap.
- Type **`vicfg-snmp.pl --server <hostname> --username <username> --password <password> --show`** to display the current configuration of the embedded SNMP agent.
- The `SNMPv2-MIB.mib` file provides a number of counters to aid in debugging SNMP problems. See "SNMPv2 Diagnostic Counters," on page 65.
- The `VMWARE-AGENTCAP-MIB.mib` file defines the capabilities of the VMware SNMP agents by product version. Use this file to determine if the SNMP functionality that you want to use is supported.

Using SNMP with Guest Operating Systems

You can use SNMP to monitor guest operating systems or applications running in virtual machines.

The virtual machine uses its own virtual hardware devices. Do not install agents in the virtual machine that are intended to monitor physical hardware.

Procedure

- Install the SNMP agents you normally would use for that purpose in the guest operating systems. No special configuration is required on ESX.

VMware MIB Files

VMware MIB files define the information provided by ESX/ESXi hosts and vCenter Server to SNMP management software. You can download these MIB files from the VMware Web site.

Table 5-1 lists the MIB files provided by VMware and describes the information that each file provides.

Table 5-1. VMware MIB Files

MIB File	Description
VMWARE-ROOT-MIB.mib	Contains VMware's enterprise OID and top level OID assignments.
VMWARE-AGENTCAP-MIB.mib	Defines the capabilities of the VMware agents by product versions.
VMWARE-ENV-MIB.mib	Defines variables and trap types used to report on the state of physical hardware components of the host computer.
VMWARE-OBSOLETE-MIB.mib	Defines OIDs that have been made obsolete to maintain backward compatibility with earlier versions of ESX/ESXi. Includes variables formerly defined in the files VMWARE-TRAPS-MIB.mib and VMWARE-VMKERNEL-MIB.mib.
VMWARE-PRODUCTS-MIB.mib	Defines OIDs to uniquely identify each SNMP agent on each VMware platform by name, version, and build platform.
VMWARE-RESOURCES-MIB.mib	Defines variables used to report information on resource usage of the VMkernel, including physical memory, CPU, and disk utilization.
VMWARE-SYSTEM-MIB.mib	The VMWARE-SYSTEM-MIB.mib file is obsolete. Use the SNMPv2-MIB to obtain information from sysDescr.0 and sysObjec ID.0.
VMWARE-TC-MIB.mib	Defines common textual conventions used by VMware MIB files.
VMWARE-VC-EVENTS-MIB.mib	Defines traps sent by vCenter Server. Load this file if you use vCenter Server to send traps.
VMWARE-VMINFO-MIB.mib	Defines variables for reporting information about virtual machines, including virtual machine traps.

Table 5-2 lists MIB files included in the VMware MIB files package that are not created by VMware. These can be used with the VMware MIB files to provide additional information.

Table 5-2. Other MIB Files

MIB File	Description
IF-MIB.mib	Defines attributes related to physical NICs on the host system.
SNMPv2-CONF.mib	Defines conformance groups for MIBs.
SNMPv2-MIB.mib	Defines the SNMP version 2 MIB objects.
SNMPv2-TC.mib	Defines textual conventions for SNMP version 2.

VMWARE-ROOT-MIB

The VMWARE-ROOT-MIB.mib file defines the VMware enterprise OID and top level OID assignments.

Table 5-3 lists the identification mapping defined in VMWARE-ROOT-MIB.mib.

Table 5-3. Definition Mapping for VMWARE-ROOT-MIB.mib

Label	Identification Mapping
vmware	enterprises 6876
vmwSystem	vmware 1
vmwVirtMachines	vmware 2
vmwResources	vmware 3
vmwProductSpecific	vmware 4
vmwLdap	vmware 40
vmwTraps	vmware 50
vmwOID	vmware 60
vmwareAgentCapabilities	vmware 70
vmwExperimental	vmware 700
vmwObsolete	vmware 800

VMWARE-ENV-MIB

The VMWARE-ENV-MIB.mib defines variables and trap types used to report on the state of physical components of the host computer.

VMWARE-ENV-MIB.mib defines two traps:

- vmwEnvHardwareEvent, which is sent when an ESXi host has detected a material change in the physical condition of the hardware.
- vmwESXEnvHardwareEvent, which is sent when an ESX host has detected a material change in the physical condition of the hardware.

Table 5-4 lists the variables defined in VMWARE-ENV-MIB.mib.

Table 5-4. Variable Definitions in VMWARE-ENV-MIB

Variable	ID Mapping	Description
vmwEnv	vmwProductSpecific 20	Defines the OID root for this MIB module.
vmwEnvNumber	vmwEnv 1	Number of conceptual rows in vmwEnvTable.
vmwEnvLastChange	vmwEnv 2	The value of sysUptime when a conceptual row was last added to or deleted from vmwEnvTable.
vmwEnvTable	vmwEnv 3	This table is populated by monitoring subsystems such as IPMI.
vmwEnvEntry	vmwEnvTable 1	One entry is created in the table for each physical component reporting its status to ESX/ESXi.
vmwEnvIndex	vmwEnvEntry 1	A unique identifier for the physical component. This identifier does not persist across management restarts.

Table 5-4. Variable Definitions in VMWARE-ENV-MIB (Continued)

Variable	ID Mapping	Description
vmwSubsystemType	vmwEnvEntry 2	The type of hardware component that is reporting its environmental state.
vmwHardwareStatus	vmwEnvEntry 3	The last reported status of the component.
vmwEventDescription	vmwEnvEntry 4	A description of the last reported event for this hardware component.
vmwHardwareTime	vmwEnvEntry 5	The value of sysUptime when vmwHardwareStatus was reported.

VMWARE-OBSOLETE-MIB

The VMWARE–OBSOLETE–MIB.mib file contains all previously published managed objects that have been made obsolete. This file is provided to maintain compatibility with older versions of ESX/ESXi.

The variables defined in this file were originally defined in previous versions of the VMWARE–RESOURCES–MIB.mib and VMWARE–TRAPS–MIB.mib files. Table 5-5 lists the variables defined in VMWARE–OBSOLETE–MIB.mib.

Table 5-5. Variables Defined in VMWARE-OBSOLETE-MIB

Variable	ID Mapping	Description
Obsolete variables originally from VMWARE-RESOURCES-MIB		
vmwResources	vmware 3	
vmwCPU	vmwResources 1	Defines the root OID for the subtree of variables used to report CPU information.
vmwCpuTable	vmwCPU 2	A table of CPU usage by each virtual machine.
vmwCpuEntry	vmwCpuTable 1	An entry in cpuTable that records CPU usage for a single virtual machine.
vmwCpuVMID	vmwCpuEntry 1	The identification number allocated to the virtual machine by the VMkernel.
vmwCpuShares	vmwCpuEntry 2	The share of the CPU allocated to the virtual machine by the VMkernel.
vmwCpuUtil	vmwCpuEntry 3	Amount of time the virtual machine has been running on the CPU (in seconds).
vmwMemTable	vmwMemory 4	A table of memory usage by each virtual machine.
vmwMemEntry	vmwMemTable 1	An entry in memTable that records memory usage by a single virtual machine.
vmwMemVMID	vmwMemEntry 1	The identification number allocated to the virtual machine by the VMkernel.
vmwMemShares	vmwMemEntry 2	The shares of memory allocated to the virtual machine by the VMkernel.
vmwMemConfigured	vmwMemEntry 3	The amount of memory the virtual machine was configured with (in KB).
vmwMemUtil	vmwMemEntry 4	The amount of memory currently used by the virtual machine (in KB).
vmwHBATable	vmwResources 3	A table used for reporting disk adapter and target information.

Table 5-5. Variables Defined in VMWARE-OBSOLETE-MIB (Continued)

Variable	ID Mapping	Description
vmwHBAEntry	vmwHBATable 1	A record for a single HBA connected to the host machine.
vmwHbaIdx	vmwHBAEntry 1	Index for the HBA table.
vmwHbaName	vmwHBAEntry 2	A string describing the disk. Format: <devname#>:<tgt>:<lun>.
vmwHbaVMID	vmwHBAEntry 3	The identification number allocated to the running virtual machine by the VMkernel.
vmwDiskShares	vmwHBAEntry 4	Share of disk bandwidth allocated to this virtual machine.
vmwNumReads	vmwHBAEntry 5	Number of reads to this disk since the disk module was loaded.
vmwKbRead	vmwHBAEntry 6	Kilobytes read from this disk since the disk module was loaded.
vmwNumWrites	vmwHBAEntry 7	Number of writes to this disk since the disk module was loaded.
vmwKbWritten	vmwHBAEntry 8	Number of kilobytes written to this disk since the disk module was loaded.
vmwNetTable	vmwResources 4	A table used for reporting network adapter statistics.
vmwNetEntry	vmwNetTable 1	A record for a single network adapter on the virtual machine.
vmwNetIdx	vmwNetEntry 1	Index for the network table.
vmwNetName	vmwNetEntry 2	A string describing the network adapter.
vmwNetVMID	vmwNetEntry 3	The identification number allocated to the running virtual machine by the VMkernel.
vmwNetIfAddr	vmwNetEntry 4	The MAC address of the virtual machine's virtual network adapter.
vmwNetShares	vmwNetEntry 5	Share of network bandwidth allocate d to this virtual machine. This object has not been implemented.
vmwNetPktsTx	vmwNetEntry 6	The number of packets transmitted on this network adapter since the network module was loaded. Deprecated in favor of vmwNetHCPktsTx.
vmwNetKbTx	vmwNetEntry 7	The number of kilobytes sent from this network adapter since the network module was loaded. Deprecated in favor of vmwNetHCKbTx.
vmwNetPktsRx	vmwNetEntry 8	The number of packets received on this network adapter since the network module was loaded. Deprecated in favor of vmwNetHCPktsRx.
vmwNetKbRx	vmwNetEntry 9	The number of kilobytes received on this network adapter since the network module was loaded. Deprecated in favor of vmwNetHCKbRx

Table 5-5. Variables Defined in VMWARE-OBSOLETE-MIB (Continued)

Variable	ID Mapping	Description
vmwNetHCPktsTx	vmwNetEntry 10	The number of packets transmitted on this network adapter since the network module was loaded. This counter is the 64-bit version of vmwNetPktsTx.
vmwNetHCKbTx	vmwNetEntry 11	The number of kilobytes sent from this network adapter since the network module was loaded. This counter is the 64-bit version of vmwNetKbTx.
vmwNetHCPktsRx	vmwNetEntry 12	The number of packets received on this network adapter since the network module was loaded. This counter is the 64-bit version of vmwNetPktsRx.
vmwNetHCKbRx	vmwNetEntry 13	The number of kilobytes received on this network adapter since the network module was loaded. This counter is the 64-bit versin of vmwNetKbRx.
Obsolete variables originally defined in VMWARE-TRAPS-MIB		
vmID	vmwTraps 101	The ID of the affected virtual machine generating the trap. If there is no virtual machine ID (for example, if the virtual machine has been powered off), the vmID is -1.
vmConfigFile	vmwTraps 102	The configuration file of the virtual machine generating the trap.
vpxdTrapType	vmwTraps 301	The trap type of the vCenter Server trap.
vpxdHostName	vmwTraps 302	The name of the affected host.
vpxdVMName	vmwTraps 303	The name of the affected virtual machine.
vpxdOldStatus	vmwTraps 304	The prior status.
vpxdNewStatus	vmwTraps 305	The new status.
vpxdObjValue	vmwTraps 306	The object value.

Table 5-6 lists the traps defined in VMWARE-OBSOLETE-MIB.mib. These traps were originally defined in VMWARE-TRAPS-MIB.mib.

Table 5-6. Traps Defined in VMWARE-OBSOLETE-MIB

Trap	Description
ESX/ESXi Traps	
vmPoweredOn	This trap is sent when a virtual machine is powered on from a suspended or powered off state.
vmPoweredOff	This trap is sent when a virtual machine is powered off.
vmHBLost	This trap is sent when a virtual machine detects a loss in guest heartbeat. VMware Tools must be installed in the guest operating system in order for this value to be valid.
vmHBDetected	This trap is sent when a virtual machine detects or regains the guest heartbeat. VMware Tools must be installed in the guest operating system in order for this value to be valid.
vmSuspended	This trap is sent when a virtual machine is suspended.
vCenter Server Traps	
vpxdTrap	This trap is sent when an entity status has changed.

VMWARE-PRODUCTS-MIB

The VMWARE-PRODUCTS-MIB.mib file defines OIDs to uniquely identify each SNMP agent on each VMware platform.

Table 5-7 lists identification mappings defined in VMWARE-PRODUCTS-MIB.mib.

Table 5-7. Identification Mappings for VMWARE-PRODUCTS-MIB.mib

Label	Identification Mapping
oidESX	vmwOID 1
vmwESX	vmwProductSpecific 1
vmwDVS	vmwProductSpecific 2
vmwVC	vmwProductSpecific 3
vmwServer	vmwProductSpecific 4

VMWARE-RESOURCES-MIB

The VMWARE-RESOURCES-MIB.mib file defines variables used to report information on resource usage.

Table 5-8 lists the identification mappings defined in VMWARE-RESOURCES-MIB.mib.

Table 5-8. Identification Mappings for VMWARE-RESOURCES-MIB

Variable	ID Mapping	Description
CPU Subtree		
vmwCPU	vmwResources 1	Defines the root OID for the subtree of variables used to report CPU information.
vmwNumCPUs	vmwCPU 1	The number of physical CPUs present on the system.
Memory Subtree		
vmwMemory	vmwResources 2	Defines the root OID for the subtree of variables used to report memory information.
vmwMemSize	vmwMemory 1	Amount of physical memory present on the host (in KB).
vmwMemCOS	vmwMemory 2	Amount of physical memory allocated to the service console (in KB). This variable does not apply to ESXi hosts, which do not have a service console.
vmwMemAvail	vmwMemory 3	The amount of memory available to run virtual machines and to allocate to the hypervisor. It is computed by subtracting vmwMemCOS from vmwMemSize.
Storage Subtree		
vmwStorage	vmwResources 5	Defines the root OID for the subtree of variables used to report memory information.
vmwHostBusAdapterNumber	vmwStorage 1	The number of entries in the vmwHostBusAdapterTable.
vmwHostBusAdapterTable	vmwStorage 2	A table of Host Bus Adapters found in this host.
vmwHostBusAdapterEntry	vmwHostBusAdapterTable 1	An entry in the Host Bus Adapter table holding details for a particular adapter.
vmwHostBusAdapterIndex	vmwHostBusAdapterEntry 1	An arbitrary index assigned to this adapter.
vmwHbaDeviceName	vmwHostBusAdapterEntry 2	The system device name for this adapter.

Table 5-8. Identification Mappings for VMWARE-RESOURCES-MIB (Continued)

Variable	ID Mapping	Description
vmwHbaBusNumber	vmwHostBusAdapterEntry 3	The host bus number. For unsupported adapters, returns -1.
vmwHbaStatus	vmwHostBusAdapterEntry 4	The operational status of the adapter.
vmwHbaModelName	vmwHostBusAdapterEntry 5	The model name of the adapter.
vmwHbaDriverName	vmwHostBusAdapterEntry 6	The name of the adapter driver.
vmwHbaPci	vmwHostBusAdapterEntry 7	The PCI ID of the adapter.

VMWARE-SYSTEM-MIB

The VMWARE-SYSTEM-MIB.mib file provides variables for identifying the VMware software running on a managed system by product name, version number, and build number.

Table 5-9 lists the variables defined in VMWARE-SYSTEM-MIB.mib.

Table 5-9. Variables Defined in VMWARE-SYSTEM-MIB

Variable	ID Mapping	Description
vmwProdName	vmwSystem 1	The product name.
vmwProdVersion	vmwSystem 2	The product version number, in the format *<Major>.<Minor>.<Update>*.
vmwProdBuild	vmwSystem 4	The product build number.

VMWARE-TC-MIB

The VMWARE-TC-MIB.mib file provides common textual conventions used by VMware MIB files.

VMWARE-TC-MIB.mib defines the following integer values for VmwSubsystemTypes:

- unknown(1)
- chassis(2)
- powerSupply(3)
- fan(4)
- cpu(5)
- memory(6)
- battery(7)
- temperatureSensor(8)
- raidController(9)
- voltage(10)

VMWARE-TC-MIB.mib defines the following integer values for VmwSubsystemStatus:

- unknown(1)
- normal(2)
- marginal(3)
- critical(4)
- failed(5)

VMWARE-VC-EVENT-MIB

The VMWARE-VC-EVENT-MIB.mib file provides definitions for traps sent by vCenter Server. These definitions were provided by VMWARE-TRAPS-MIB.mib in earlier versions of VirtualCenter Server.

Table 5-10 lists the traps defined for vCenter Server.

Table 5-10. Alarms Defined in VMWARE-VC-EVENT-MIB

Trap	ID Mapping	Description
vpxdAlarmInfo	vmwVCNotifications 201	The vCenter Server SNMP agent sends this trap when an entity's alarm status changes.
vpxdDiagnostic	vmwVCNotifications 202	The vCenter Server SNMP agent sends this trap when vCenter Server starts or is restarted, or when a test notification is requested. vCenter Server can be configured to send this trap periodically at regular intervals.

Table 5-11 lists the variables defined for the vCenter Server traps.

Table 5-11. Variables Defined in VMWARE-VC-EVENT-MIB

Variable	ID Mapping	Description
vmwVpxdTrapType	vmwVC 301	The trap type of the vCenter Server trap.
vmwVpxdTargetObjType	vmwVC 302	The name of the affected host.
vmwVpxdVMName	vmwVC 303	The name of the affected virtual machine.
vmwVpxdOldStatus	vmwVC 304	The prior status.
vmwVpxdNewStatus	vmwVC 305	The new status.
vmwVpxdObjValue	vmwVC 306	The object value.

VMWARE-VMINFO-MIB

The VMWARE-VMINFO-MIB.mib file defines variables and traps for reporting virtual machine information.

Table 5-12 lists the variables defined in VMWARE-VMINFO-MIB.mib.

Table 5-12. Identification Mappings for VMWARE-VMINFO-MIB

Variable	ID Mapping	Description
Virtual Machine Variables		
vmwVmTable	vmwVirtMachines 1	A table containing information on the virtual machines that have been configured on the system.
vmwVmEntry	vmwVmTable 1	The record for a single virtual machine.
vmwVmIdx	vmwVmEntry 1	An index for the virtual machine entry.
vmwVmDisplayName	vmwVmEntry 2	The display name for the virtual machine.
vmwVmConfigFile	vmwVmEntry 3	The path to the configuration file for this virtual machine.
vmwVmGuestOS	vmwVmEntry 4	The guest operating system running on the virtual machine.
vmwVmMemSize	vmwVmEntry 5	The memory (in MB) configured for this virtual machine.
vmwVmState	vmwVmEntry 6	The virtual machine power state (on or off).

Table 5-12. Identification Mappings for VMWARE-VMINFO-MIB (Continued)

Variable	ID Mapping	Description
vmwVmVMID	vmwVmEntry 7	An identification number assigned to running virtual machines by the VMkernel. Powered-off virtual machines to not have this ID.
vmwVmGuestState	vmwVmEntry 8	The state of the guest operating system (on or off).
vmwVmCpus	vmwVmEntry 9	The number of virtual CPUs assigned to this virtual machine.
Virtual Machine HBA Variables		
vmwVmHbaTable	vmwVirtMachines 2	A table of HBAs visible to a virtual machine.
vmwVmHbaEntry	vmwVmHbaTable 1	Record for a single HBA.
vmwHbaVmIdx	vmwVmHbaEntry 1	A number corresponding to the virtual machine's index in the vmwVmTable.
vmwVmHbaIdx	vmwVmHbaEntry 2	Uniquely identifies a given HBA in this VM. May change across system reboots.
vmwHbaNum	vmwVmHbaEntry 3	The name of the HBA as it appears in the virtual machine settings.
vmwHbaVirtDev	vmwVmHbaEntry 4	The HBA hardware being emulated to the guest operating system.
vmwHbaTgtTable	vmwVirtMachines 3	The table of all virtual disks configure for virtual machines in vmwVmTable.
vmwHbaTgtEntry	vmwHbaTgtTable 1	A record for a specific storage disk. May change across reboots.
vmwHbaTgtVmIdx	vmwHbaTgtEntry 1	A number corresponding to the virtual machine's index (vmwVmIdx) in the vmwVmTable.
vmwHbaTgtIdx	vmwHbaTgtEntry 2	This value identifies a particular disk.
vmwHbaTgtNum	vmwHbaTgtEntry 3	Identifies the disk as seen from the host bus controller.
Virtual Machine Network Variables		
vmwVmNetTable	vmwVirtMachines 4	A table of network adapters for all virtual machines in vmwVmTable.
vmwVmNetEntry	vmwVmNetTable 1	Identifies a unique network adapter in this table.
vmwVmNetVmIdx	vmwVmNetEntry 1	A number corresponding to the virtual machine's index in the vmwVmTable.
vmwVmNetIdx	vmwVmNetEntry 2	Identifies a unique network adapter in this table. May change across sytem reboots.
vmwVmNetNum	vmwVmNetEntry 3	The name of the network adapter as it appears in the virtual machine settings.
vmwVmNetName	vmwVmNetEntry 4	Identifies what the network adapter is connected to.
vmwVmNetConnType	vmwVmNetEntry 5	Obsolete. Do not use.
vmwVmNetConnected	vmwVmNetEntry 6	Reports true if the ethernet virtual device is connected to the virtual machine.
vmwVmMAC	vmwVmNetEntry 7	Reports the configured virtual hardware MAC address. If VMware Tools is not running, the value is zero or empty.
Virtual Floppy Device Variables		
vmwFloppyTable	vmwVirtMachines 5	A table of floppy drives for all virtual machines in vmwVmTable.

Table 5-12. Identification Mappings for VMWARE-VMINFO-MIB (Continued)

Variable	ID Mapping	Description
vmwFloppyEntry	vmwFloppyTable 1	Identifies a single floppy device. May change across system reboots.
vmwFdVmIdx	vmwFloppyEntry 1	A number corresponding to the virtual machine's index in the vmwVmTable.
vmwFdIdx	vmwFloppyEntry 2	Identifies a specific virtual floppy device.
vmwFdName	vmwFloppyEntry 3	The file or device that this virtual floppy device is connected to.
vmwFdConnected	vmwFloppyEntry 4	Reports true if the floppy device is connected.
Virtual DVD or CD-ROM Variables		
vmwCdromTable	vmwVirtMachines 6	A table of DVD or CD-ROM drives for all virtual machines in vmwVmTable.
vmwCdromEntry	vmwCdromTable 1	Identifies a specific CD-ROM or DVD drive. May change across system reboots.
vmwCdVmIdx	vmwCdromEntry 1	A number corresponding to the virtual machine's index in the vmwVmTable.
vmwCdromIdx	vmwCdromEntry 2	Identifies the specific DVD or CD-ROM drive.
vmwCdromName	vmwCdromEntry 3	The file or device that the virtual DVD or CD-ROM drive has been configured to use.
vmwCdromConnected	vmwCdromEntry 4	Reports true the CD-ROM device is connected.
Virtual Machine Trap Variables		
vmwVmID	vmwTraps 101	Holds the same value as vmwVmVMID of the affected virtual machine generating the trap, to allow polling of the affected virtual machine in vmwVmTable.
vmwVmConfigFilePath	vmwTraps 102	The configuration file of the virtual machine generating the trap.

Table 5-13 lists the traps defined in VMWARE-VMINFO-MIB.mib. These traps were formely defined in VMWARE-TRAPS-MIB.mib.

Table 5-13. Traps Defined in VMWARE-VMINFO-MIB

Trap	ID Mapping	Description
vmwVmPoweredOn	vmwVmNotifications 1	This trap is sent when a virtual machine is powered on from a suspended or powered off state.
vmwVmPoweredOff	vmwVmNotifications 2	This trap is sent when a virtual machine is powered off.
vmwVmHBLost	vmwVmNotifications 3	This trap is sent when a virtual machine detects a loss in guest heartbeat. VMware Tools must be installed in the guest operating system in order for this value to be valid.
vmwVmHBDetected	vmwVmNotifications 4	This trap is sent when a virtual machine detects or regains the guest heartbeat. VMware Tools must be installed in the guest operating system in order for this value to be valid.
vmwVmSuspended	vmwVmNotifications 5	This trap is sent when a virtual machine is suspended.

SNMPv2 Diagnostic Counters

The `SNMPv2-MIB.mib` file provides a number of counters to aid in debugging SNMP problems.

Table 5-14 lists some of these diagnostic counters.

Table 5-14. Diagnostic Counters from SNMPv2-MIB

Variable	ID Mapping	Description
`snmpInPkts`	`snmp 1`	The total number of messages delivered to the SNMP entity from the transport service.
`snmpInBadVersions`	`snmp 3`	The total number of SNMP messages that were delivered to the SNMP entity and were for an unsupported SNMP version.
`snmpInBadCommunityNames`	`snmp 4`	The total number of community-based SNMP messages delivered to the SNMP entity that used an invalid SNMP community name.
`snmpInBadCommunityUses`	`snmp 5`	The total number of community-based SNMP messages delivered to the SNMP entity that represented an SNMP operation that was not allowed for the community named in the message.
`snmpInASNParseErrs`	`snmp 6`	The total number of ASN.1 or BER errors encountered by the SNMP entity when decoding received SNMP messages.
`snmpEnableAuthenTraps`	`snmp 30`	Indicates whether the SNMP entity is permitted to generate authenticationFailure traps. The value of this object overrides any configuration information. It therefore provides a means of disabling all authenticationFailure traps.
`snmpSilentDrops`	`snmp 31`	The total number of Confirmed Class PDUs delivered to the SNMP entity that were silently dropped because the size of a reply containing an alternate Response Class PDU with an empty variable-bindings field was greater than either a local constraint or the maximum message size associated with the originator of the request.
`snmpProxyDrops`	`snmp 32`	The total number of Confirmed Class PDUs delivered to the SNMP entity that were silently dropped because the transmission of the message to a proxy target failed in a manner other than a time-out such that no Response Class PDU could be returned.

System Log Files

In addition to lists of events and alarms, vSphere components generate assorted logs. These logs contain information about activities in your vSphere environment.

View System Log Entries

You can view system logs generated by vSphere components.

The following task describes how to access and view system logs.

Procedure

1 From the Home page of a vSphere Client connected to either a vCenter Server system or an ESX/ESXi host, click **System Logs**.

2 From the drop-down menu, select the log and entry you want to view.

3 Select **View > Filtering** to refer to the filtering options.

4 Enter text in the data field.

5 Click **Clear** to empty the data field.

View System Logs on an ESXi Host

You can use the direct console interface to view the system logs on an ESXi host. These logs provide information about system operational events.

Procedure

1 From the direct console, select **View System Logs**.

2 Press a corresponding number key to view a log.

vCenter Server agent (vpxa) logs appear if the host is managed by vCenter Server.

3 Press Enter or the spacebar to scroll through the messages.

4 (Optional) Perform a regular expression search.

a Press the slash key (/).

b Type the text to find.

c Press Enter

The found text is highlighted on the screen.

5 Press q to return to the direct console.

External System Logs

VMware technical support might request several files to help resolve any issues you have with the product. This section describes the types and locations of log files found on various ESX 4.0 component systems.

NOTE On Windows systems, several log files are stored in the Local Settings directory, which is located at `C:\Documents and Settings\<user name>\Local Settings\`. This folder is hidden by default.

ESX/ESXi System Logs

You may need the ESX/ESXi system log files to resolve technical issues.

Table 5-15 lists log files associated with ESX systems.

Table 5-15. ESX/ESXi System Logs

Component	Location
ESX Server 2.x Service log	`/var/log/vmware/vmware-serverd.log`
ESX Server 3.x or ESX Service log	`/var/log/vmware/hostd.log`
vSphere Client Agent log	`/var/log/vmware/vpx/vpxa.log`

Virtual Machine Kernel Core file	`/root/vmkernel-core.<date>`
	and
	`/root/vmkernel-log.<date>`
	These files are present after you reboot your machine.

Syslog log	`/var/log/messages`
Service Console Availability report	`/var/log/vmkernel`
VMkernel Messages	`/var/log/vmkernel`

Table 5-15. ESX/ESXi System Logs (Continued)

Component	Location
VMkernel Alerts and Availability report	`/var/log/vmkernel`
VMkernel Warning	`/var/log/vmkwarning`
Virtual Machine log file	`vmware.log` in the same directory as the `.vmx` file for the virtual machine
Virtual Machine Configuration file	*<virtual_machine_name>*`/`*<virtual_machine_name>*`.vmx` located on a datastore associated with the managed host. Used the virtual machine summary page in the vSphere Client to determine the datastore on which this file is located.

vSphere Client System Logs

You may need the vSphere Client system log files to resolve technical issues.

Table 5-16 lists log files associated with the vSphere Client machine.

Table 5-16. vSphere Client System Logs

Component	Location
vSphere Client Installation log	Temp directory on the vSphere Client machine. Example: `C:\Documents and Settings\`*<user name>*`\Local Settings\Temp\vmmsi.log` or `C:\Users\`*<user name>*`\Local Settings\Temp\vmmsi.log`
vSphere Client Service log	`\vpx` directory in the Application Data directory on the vSphere Client machine. Example: `C:\Documents and Settings\`*<user name>*`\Local Settings\Application Data\vpx\viclient-x.log` or `C:\Users\`*<user name>*`\Local Settings\Application Data\vpx\viclient-x.log` `x(=0, 1, ... 9)`

Configure Syslog on ESXi Hosts

All ESX/ESXi hosts run a syslog service (`syslogd`), which logs messages from the VMkernel and other system components to a file.

On an ESXi host, you can use the vSphere Client or the vSphere CLI command `vicfg-syslog` to configure the following options:

Log file path Specifies a datastore path to a file in which syslogd logs all messages.

Remote host Specifies a remote host to which syslog messages are forwarded. In order to receive the forwarded syslog messages, your remote host must have a syslog service installed and correctly configured. Consult the documentation for the syslog service installed on your remote host for information on configuration.

Remote port Specifies the port on which the remote host receives syslog messages.

You cannot use the vSphere Client or `vicfg-syslog` to configure syslog behavior for an ESX host. To configure syslog for an ESX host, you must edit the `/etc/syslog.conf` file.

For more information on `vicfg-syslog`, see the *vSphere Command-Line Interface Installation and Reference Guide*.

Procedure

1 In the vSphere Client inventory, select the host.

2 Click the **Configuration** tab.

3 Click **Advanced Settings**.

4 Select **Syslog** in the tree control.

5 In the **Syslog.Local.DatastorePath** text box, enter the datastore path for the file to which syslog will log messages.

The datastore path should be of the form [*<datastorename>*] *</path/to/file>*, where the path is relative to the root of the volume backing the datastore. For example, the datastore path `[storage1] var/log/messages` would map to the path `/vmfs/volumes/storage1/var/log/messages`.

If no path is specified, the default path is `/var/log/messages`.

6 In the **Syslog.Remote.Hostname** text box, enter the name of the remote host to which syslog data will be forwarded.

If no value is specified, no data is forwarded.

7 In the **Syslog.Remote.Port** text box, enter the port on the remote host to which syslog data will be forwarded.

By default, this option is set to 514, which is the default UDP port used by syslog. Changes to this option take effect only if **Syslog.Remote.Hostname** is configured.

8 Click **OK**.

Changes to the syslog options take effect immediately.

Export Diagnostic Data

You can export all or part of your log file data.

When you export log file data, the `vm-support` script creates a file of the selected data and stores it in a location you specify. The default file type is `.txt` if no other extension is specified. The file contains Type, Time, and Description.

Procedure

1 From the vSphere Client connected to a vCenter Server system or ESX/ESXi host, select **Administration > Export Diagnostic Data.**

2 If the vSphere Client is connected to a vCenter Server system, specify the host whose logs you want to export and the location for storing the log files.

3 If the vSphere Client is connected to an ESX/ESXi host, specify the location for the log files.

4 Click **OK**.

Collecting Log Files

VMware technical support might request several files to help resolve technical issues. The following sections describe script processes for generating and collecting some of these files.

Set Verbose Logging

You can specify how verbose log files will be.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 Select **Logging Options**.

3 Select **Verbose** from the pop-up menu.

4 Click **OK**.

Collect vSphere Log Files

You can collect vSphere log files into a single location.

Select from the options:

Procedure

- To view the `viclient-*.log` files, change to the directory, `%temp%`.
- If you are running the vSphere Client connected to a vCenter Server system, download the log bundle.

  The log bundle is generated as a `.zip` file. By default, the vpxd logs within the bundle are compressed as `.gz` files. You must use `gunzip` to uncompress these files.
- From the vCenter Server system, select **Start > Programs > VMware > Generate vCenter Server log bundle**.

  You can use this to generate vCenter Server log bundles even when you are unable to connect to the vCenter Server using the vSphere Client.

  The log bundle is generated as a `.zip` file. By default, the vpxd logs within the bundle are compressed as `.gz` files. You must use `gunzip` to uncompress these files.

Collect ESX Log Files Using the Service Console

You can collect and package all relevant ESX system and configuration information, a well as ESX log files. This information can be used to analyze the problems.

Procedure

- Run the following script on the service console: `/usr/bin/vm-support`

  The resulting file has the following format: `esx-<date>-<unique-xnumber>.tgz`

Turn Off Compression for vpxd Log Files

By default, vCenter Server `vpxd` log files are rolled up and compressed into `.gz` files. You can turn off this setting to leave the `vpxd` logs uncompressed.

Procedure

1. Log in to the vCenter Server using the vSphere Client.
2. Select **Administration > vCenter Server Settings**.
3. In the **Key** text box, type **`log.compressOnRoll`**.
4. In the **Value** text box, type **`false`**.
5. Click **Add**, and click **OK**.

ESX/ESXi VMkernel Files

If the VMkernel fails, an error message appears and then the virtual machine reboots. If you specified a VMware core dump partition when you configured your virtual machine, the VMkernel also generates a core dump and error log.

More serious problems in the VMkernel can freeze the machine without an error message or core dump.

Managing the vSphere Client Inventory

6

The topics in this section describe how to manage the objects in your vSphere environment.

The views and capabilities displayed vary depending on whether the vSphere Client is connected to a vCenter Server system or an ESX/ESXi host. Unless indicated, the process, task, or description applies to all kinds of vSphere Client connections.

This chapter includes the following topics:

- "Understanding vSphere Client Objects," on page 71
- "Add an Inventory Object," on page 73
- "Moving Objects in the Inventory," on page 74
- "Remove an Inventory Object," on page 74
- "Browsing Datastores in the vSphere Client Inventory," on page 75

Understanding vSphere Client Objects

Inventory objects in the vSphere Client include folders, datacenters, clusters, resource pools, datastores, and networks. These objects are used to help manage or organize monitored and managed hosts, as well as virtual machines.

Each object in the vSphere Client has a particular place in the overall object hierarchy. An object's position in the hierarchy is determined by the object's functionality.

An object's name must be unique with its parent. vApp names must be unique within the Virtual Machines and Templates view.

Identifying Objects in the vSphere Client Inventory

Inventory objects in the vSphere Client represent resources in your virtual infrastructure.

Objects in vSphere Client are as follows:

Root folder — In vCenter Server only. Child objects are datacenters or subfolders. The root folder is set as a default for every vCenter Server system. You can change the name, but not add or remove it.

In a vCenter Server Connected Group, there is one root folder for each vCenter Server system in the group. The name of the root folder is the name of the vCenter Server system which it represents.

Folders — In vCenter Server only. Child objects are datacenters, hosts, clusters, networking objects, datastores, virtual machines, templates, or subfolders.

Datacenters	In vCenter Server only. A datacenter contains folders, clusters, hosts, networks, datastores and virtual machines. All actions taken upon managed hosts and virtual machines are applied within their datacenter. Within a datacenter, you can monitor and manage virtual machines separately from their hosts and use VMotion.
Clusters	In vCenter Server only. Child objects are hosts, virtual machines, or resource pools.
Hosts	Child objects of hosts are virtual machines or resource pools. Hosts are ESX/ESXi systems. The term host refers to the virtualization platform that is the host to one or more virtual machines. A host object is the default top structure for a standalone ESX/ESXi machine. When the vCenter Server system is connected to the vSphere Client, all ESX/ESXi systems registered with vCenter Server are referred to as hosts. ESX/ESXi systems directly connected to the vSphere Client are referred to as standalone hosts.
Resource pools	Child objects of resource pools are virtual machines or other resource pools. Resource pools are available on ESX/ESXi hosts as well as through vCenter Server systems. A vSphere Client resource pool is used to allocate host-provided CPU and memory to the virtual machines resident to the host.
Virtual machines	Located within a host, virtual disks on a datastore, associated within a cluster or resource pool. Can be listed as a child object to hosts, clusters, or resource pools. Can be moved between hosts or clusters. When adding to a cluster or resource pool, you must specify or have in the cluster or resource pool a designated target host.
Templates	A template is a master copy of a virtual machine that can be used to create and provision new virtual machines.
Networks	In vCenter Server only. Child object to datacenters and network folders. There are two types of networks: vNetwork Standard Switches (vSwitches) and vNetwork Distributed Switches. vNetwork Standard Switches are associated with a single host and are discovered when hosts are added to the vSphere environment. You can add and remove vNetwork Standard Switches through the vSphere Client. vNetwork Distributed Switches span multiple hosts. You can add and remove vNetwork Distributed Switches through the vSphere Client.
Datastores	In vCenter Server only. Child object to datacenters and datastore folders. Datastores are logical containers that hold virtual disk files and other files necessary for virtual machine operations. Datastores exist on different types of physical storage devices, including local storage, iSCSI and Fibre Channel SANs, and NFS. You create datastores by formatting storage devices or by mounting NFS volumes on your host. In addition, you can add a host with existing datastores to the inventory.
Libraries	Central repositories for virtual machine provisioning media such as virtual machine templates, ISO images, floppy images, VMDK files, guest customization files, and so on.

Viewing Object Relationships

One of the features of managing your virtual infrastructure with vSphere is viewing relationships between inventory objects.

You can view the relationships between inventory objects relationships in the following ways:

Using the Maps feature	Shows the inventory object relationships in graphical form.
Clicking an object in the inventory	Provides a list of tabbed content that lists related objects. For example, a datastore has a virtual machine tab that lists the virtual machines that use the datastore. There is also a host tab that list the hosts that can access the datastore.
Selecting Hosts and Clusters from the Home page	Provides a view of the set of virtual machines that run on a particular host, cluster, or resource pool. Each object has a tab that displays all the virtual machines associated or contained within it. When you view the hosts and clusters page, virtual machine folders are not displayed. Because virtual machine names are unique within virtual machine folders, you might see more than one virtual machine with the same name. To view virtual machines as they are arranged in the folder hierarchy, use the VMs and Templates view.
Selecting VMs and Templates from the Home page	Displays all virtual machines and templates. Through this view you can organize virtual machines into folder hierarchies.
Selecting Datastores from the Home page	Displays all datastores in the datacenter. Through this view you can organize datastores into arbitrary folder hierarchies.
Selecting Networking objects from the Home page	Displays all abstract network devices, called vSwitches and vNetwork Distributed Switches. Through this view you can organize networking devices into arbitrary folder hierarchies.

Add an Inventory Object

You can add an inventory object only to its corresponding hierarchical parent. Objects you are allowed to add are listed on the parent menus.

Add a Cluster, Resource Pool, Host, or Virtual Machine

Clusters, resource pools, hosts, and virtual machines can be added from the Hosts and Clusters view in vSphere Client.

Procedure

1 From the vSphere Client, right-click the parent object in the inventory.

2 Select `New <Object>`, where <*Object*> is a folder, datacenter, cluster, resource pool, host, or virtual machine.

3 Complete the wizard and click **Finish**.

Add a Folder or Datacenter

Folders and datacenters add organization to your inventory. Add folders or datacenters from any Inventory view in the vSphere Client.

Procedure

1 From the vSphere Client, right-click the parent object in the inventory.

2 Select `New <Object>`, where *<Object>* is a folder, datacenter, cluster, resource pool, host, or virtual machine.

An icon representing the new object is added to the inventory.

3 Enter a name for the object.

Moving Objects in the Inventory

You can move most objects manually between folders, datacenters, resource pools, and hosts in the vSphere Client inventory.

You cannot move the root folder. If you connect directly to a host using the vSphere Client, you cannot move the host.

You can move inventory objects in the following ways:

- Folders — move within a datacenter.
- Datacenter — move between folders at a sibling or parent level.
- Cluster — move between folders and within datacenters at a sibling or parent level.
- Host — move between clusters and datacenters. When managed by vCenter Server, if a host is in a cluster, all virtual machines on the host must be shut down and the host must be placed into maintenance mode before it can be moved from the cluster.
- Resource pools — move to other resource pools and folders.
- Virtual machines — move to other resource pools, clusters, folders, datacenters, or hosts. When adding to anything other than a host, you must specify a target host.
- Networks — move between folders at a sibling or parent level. You cannot move a dvPort Group independently of its parent Distributed Virtual Switch.
- Datastores — move between folders at a sibling or parent level.

Remove an Inventory Object

Removing an object from the inventory discontinues the management of the object by vCenter Server.

When you remove an object (such as a folder, datacenter, cluster, or resource pool) from the inventory, vCenter Server does the following:

- Removes all of the object's child inventory objects.
- Removes all the tasks and alarms associated with the object.
- Returns all processor and migration licenses assigned to the object to available status.
- If the object is a host, ceases to manage the object's virtual machines, but allows them to remain on the host.

NOTE Removing a virtual machine from the inventory does not delete it from its datastore.

Procedure

1 From the vSphere Client, right-click the object and select **Remove**.

2 In the confirmation dialog box that appears, confirm that you want to remove the object.

Browsing Datastores in the vSphere Client Inventory

The Datastore Browser allows you to manage the contents of datastores in the vSphere Client inventory.

To use the Datastore Browser, you need to have a role with the Browse Datastore privilege.

You can use the Datastore Browser to:

- View or search the contents of a datastore.
- Add a virtual machine or template stored on a datastore to the vSphere Client inventory.
- Copy or move files from one location to another, including to another datastore.
- Upload a file or folder from the client computer to a datastore.
- Download a file from a datastore to the client computer.
- Delete or rename files on a datastore.

The Datastore Browser operates in a manner similar to file system applications like Windows Explorer. It supports many common file system operations, including copying, cutting, and pasting files. The Datastore Browser does not support drag-and-drop operations.

Copying Virtual Machine Disks with the Datastore Browser

You can use the Datastore Browser to copy virtual machine disk files between hosts. Disk files are copied as-is, without any format conversion. Disks copied from one type of host to a different type of host might require conversion before they can be used on the new host.

You can download virtual disks from a datastore to local storage, but you cannot upload virtual disks from local storage to a datastore, because the disk format cannot be verified during the upload.

Managing Hosts in vCenter Server 7

To access the full capabilities of your hosts and to simplify the management of multiple hosts, you should connect your hosts to a vCenter Server system.

For information on configuration management of ESX/ESXi hosts, see the *ESX Configuration Guide* or *ESXi Configuration Guide*.

The views and capabilities displayed vary depending on whether the vSphere Client is connected to a vCenter Server system or an ESX/ESXi host. Unless indicated, the process, task, or description applies to all kinds of vSphere Client connections.

This chapter includes the following topics:

- "About Hosts," on page 77
- "Add a Host," on page 78
- "Completing the Add Host Process," on page 79
- "Disconnecting and Reconnecting a Host," on page 80
- "Remove a Host from a Cluster," on page 81
- "Understanding Managed Host Removal," on page 81
- "Remove a Managed Host from vCenter Server," on page 82
- "Monitoring Host Health Status," on page 83

About Hosts

A host is a virtualization platform that supports virtual machines. A vCenter Server managed host is a host that is registered with vCenter Server.

The task of managing a host is accomplished through the vSphere Client. This vSphere Client can be connected either directly to an ESX/ESXi host or indirectly to hosts through a connection to a vCenter Server system.

When ESX/ESXi hosts are connected to the vSphere Client directly, you manage them individually as standalone hosts. Most of the host configuration and virtual machine configuration features still apply. Features that require multiple hosts, such as migration with VMotion of a virtual machine from one host to another, are not available through the standalone host connection.

When ESX/ESXi hosts are managed by vCenter Server, they are added to the vSphere environment through a vSphere Client connected to a vCenter Server system. Managed hosts are hierarchically placed in datacenters, folders, or clusters under the root vCenter Server system.

CAUTION If an ESX/ESXi host is connected with a vCenter Server system and you attached a vSphere Client to manage the ESX/ESXi host directly, you receive a warning message but are allowed to proceed. This might result in conflicts on the host, especially if the host is part of a cluster. This action is strongly discouraged.

All virtual machines on managed hosts are discovered and imported into vCenter Server. When you add multiple managed hosts, vCenter Server identifies any naming conflicts that exist between virtual machines and alerts the system administrator, who can then rename virtual machines as necessary.

When vCenter Server connects to a managed host, it does so as a privileged user. The individual vSphere Client user does not necessarily need to be an administrative user on the managed host.

Add a Host

To manage ESX/ESXi hosts using vCenter Server, you must add the hosts to the vSphere environment through the vSphere Client.

When you add a host, vCenter Server discovers and adds all the virtual machines contained within that managed host to the environment.

Before you begin this task:

- Ensure a communication channel through a firewall, if needed. If any managed host in the vCenter Server environment is behind a firewall, ensure that the managed host can communicate with vCenter Server and with all other hosts. See the *ESX Server Configuration Guide* or the *ESXi Server Configuration Guide* for information on which ports are necessary.
- Make sure NFS mounts are active. If NFS mounts are unresponsive, the operation fails.

NOTE If you are connecting your vSphere Client to an ESX/ESXi host directly, the tasks in this section do not apply.

Add a Host to a vCenter Server Cluster

Use the vSphere Client to add a host to a cluster.

Procedure

1. In the vSphere Client, display the inventory and select the cluster where you will add the host.
2. From the File menu, select **New > Add Host**.
3. Enter the managed host connection settings and click **Next**.
   a. Type the name or IP address of the managed host in the **Host** name field.
   b. Enter the **Username** and **Password** for a user account that has administrative privileges on the selected managed host.

      vCenter Server uses the root account to log in to the system and then creates a special user account. vCenter Server then uses this account for all future authentication.
4. (Optional) Select **Enable Lockdown Mode** to disable remote access for the administrator account after vCenter Server takes control of this host.

   This option is available for ESXi hosts only. Selecting this check box ensures that the host is managed only through vCenter Server. Certain limited management tasks can be performed while in lockdown mode by logging into the local console on the host.

5 Confirm the Host Summary information and click **Next**.

6 Select whether to assign a new or existing license key to the host and click **Next**.

7 Specify what should happen to the resource pools on the host.

The options are:

- Put all the host's virtual machines into the cluster's root resource pool.
- Create new resource pool for the host's virtual machines. The default resource pool name is derived from the host's name. Type over the text to supply your own name.

8 Click **Next**.

9 Click **Finish**.

Add a Host to a vCenter Server Datacenter

Use the vSphere Client to add a host to a datacenter.

Procedure

1 In the vSphere Client, display the inventory and select the datacenter or folder where you will add the host.

2 Select **File > New > Add Host**.

3 Enter the managed host connection settings and click **Next**.

a Type the name or IP address of the managed host in the **Host** name field.

b Enter the **Username** and **Password** for a user account that has administrative privileges on the selected managed host.

vCenter Server uses the root account to log in to the system and then creates a special user account. vCenter Server then uses this account for all future authentication.

4 (Optional) Select **Enable Lockdown Mode** to disable remote access for the administrator account after vCenter Server takes control of this host.

This option is available for ESXi hosts only. Selecting this check box ensures that the host is managed only through vCenter Server. Certain limited management tasks can be performed while in lockdown mode by logging into the local console on the host.

5 Confirm the Host Summary information and click **Next**.

6 Select whether to assign a new or existing license key to the host and click **Next**.

7 Select the location for the host's virtual machines and click **Next**.

Select a virtual machine folder, or the datacenter itself if you do not want to place the virtual machines into a folder.

8 Click **Finish**.

Completing the Add Host Process

After you complete the Add Host wizard, vCenter Server verifies that the host is compatible and completes the process of adding it to the vCenter Server inventory.

After you dismiss the Add Host wizard, vCenter Server finishes the process of adding a host by performing the following steps.

1 Searches the network for the specified managed host and identifies all the virtual machines on the managed host.

2 Connects to the managed host.

If the wizard cannot connect to the managed host, the managed host is not added to the inventory.

3 Verifies that the managed host is not already being managed.

If the host is already being managed by another vCenter Server system, vCenter Server displays a message. If the vCenter Server can connect to the managed host, but for some reason cannot remain connected, the host is added, but is in a disconnected state.

4 Reads the number of processors on the managed host and allocates the appropriate number of licenses.

The number of processors is stored in the vCenter Server database and is verified upon each managed host reconnection and vCenter Server system startup.

5 Verifies that the managed host version is supported.

If it is not, and the managed host version can be upgraded, vCenter Server prompts you to perform an upgrade.

6 Imports existing virtual machines.

Disconnecting and Reconnecting a Host

You can disconnect and reconnect a host that is being managed by vCenter Server. Disconnecting a managed host does not remove it from vCenter Server; it temporarily suspends all monitoring activities performed by vCenter Server.

The managed host and its associated virtual machines remain in the vCenter Server inventory. By contrast, removing a managed host from vCenter Server removes the managed host and all its associated virtual machines from the vCenter Server inventory.

Disconnect a Managed Host

Use the vSphere Client to disconnect a managed host from vCenter Server.

Procedure

1 From the vSphere Client connected to a vCenter Server system, display the inventory and click the managed host to disconnect.

2 Right-click the host and select **Disconnect** from the pop-up menu.

3 In the confirmation dialog box that appears, click **Yes**.

If the managed host is disconnected, the word “disconnected” is appended to the object name in parentheses, and the object is dimmed. All associated virtual machines are similarly dimmed and labeled.

Reconnect a Managed Host

Use the vSphere Client to reconnect a managed host to a vCenter Server system.

Procedure

1 From the vSphere Client connected to a vCenter Server system, display the inventory and click the managed host to reconnect.

2 Right-click the host and select **Connect** from the pop-up menu.

When the managed host’s connection status to vCenter Server is changed, the statuses of the virtual machines on that managed host are updated to reflect the change.

Reconnecting Hosts After Changes to the vCenter Server SSL Certificate

vCenter Server uses an SSL certificate to encrypt and decrypt host passwords stored in the vCenter Server database. If the certificate is replaced or changed, vCenter Server cannot decrypt host passwords, and therefore cannot connect to managed hosts.

If vCenter Server fails to decrypt a host password, the host is disconnected from vCenter Server. You must reconnect the host and supply the login credentials, which will be encrypted and stored in the database using the new certificate.

Remove a Host from a Cluster

When a host is removed from a cluster, the resources it provides are deducted from the total cluster resources. The virtual machines deployed on the host are either migrated to other hosts within the cluster, or remain with the host and are removed from the cluster, depending on the state of the virtual machines when the host is removed from the cluster.

You can remove hosts from a cluster by selecting them in the inventory and dragging them to a new location within the inventory. The new location can be a folder as a standalone host or another cluster.

Prerequisites

Before you can remove a host from a cluster, you must power off all virtual machines that are running on the host, or migrate the virtual machines to a new host using VMotion.

Procedure

1 From the vSphere Client connected to a vCenter Server system, display the inventory.

2 Right-click the appropriate managed host icon in the inventory panel, and select **Enter Maintenance Mode** from the pop-up menu.

3 In the confirmation dialog that appears, click **Yes**.

The host icon changes and the term “maintenance mode” is added to the name in parentheses.

4 Select the host icon in the inventory panel, and drag it to the new location.

The host can be moved to another cluster or another datacenter. When the new location is selected, a blue box surrounds the cluster or datacenter name.

vCenter Server moves the host to the new location.

5 Right-click the host, and select **Exit Maintenance Mode** from the pop-up menu.

6 (Optional) Restart any virtual machines, as needed.

Understanding Managed Host Removal

Removing a managed host from vCenter Server breaks the connection and stops all monitoring and managing functions of that managed host and of all the virtual machines on that managed host. The managed host and its associated virtual machines are removed from the inventory.

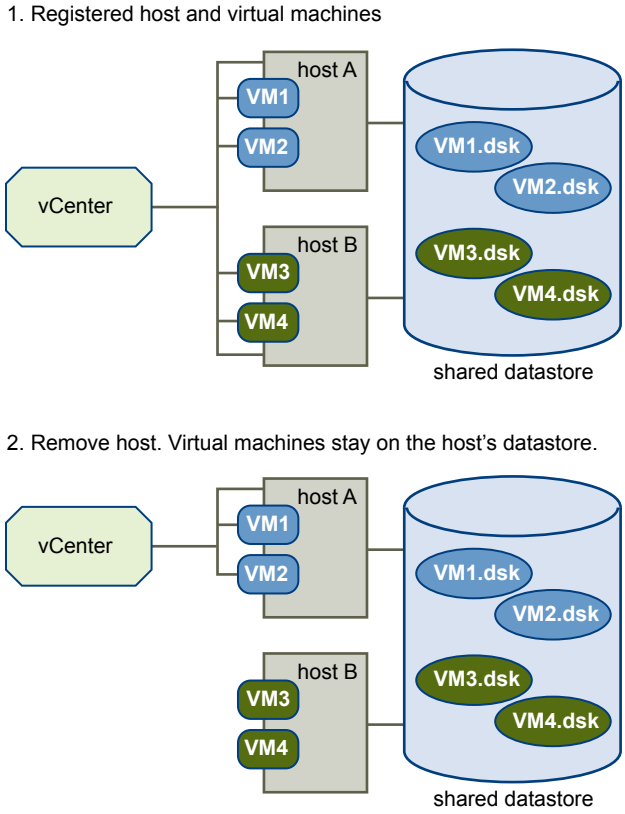
Historical data for removed hosts remains in the vCenter Server database.

Removing a managed host differs from disconnecting the managed host from vCenter Server. Disconnecting a managed host does not remove it from vCenter Server; it temporarily suspends all vCenter Server monitoring activities. The managed host and its associated virtual machines remain in the vCenter Server inventory.

Removing a managed host from vCenter Server does not remove the virtual machines from the managed host or datastore. It removes only vCenter Server’s access to the managed host and virtual machines on that managed host.

Figure 7-1 illustrates the process for removing a managed host from vCenter Server. In the example here, notice the lost link between vCenter Server and the removed managed host, while the managed host files remain on the datastore.

Figure 7-1. Removing a Host



Remove a Managed Host from vCenter Server

Remove a managed host from vCenter Server to stop all vCenter Server monitoring and management of that host.

If possible, remove managed hosts while they are connected. Removing a disconnected managed host does not remove the vCenter Server agent from the managed host.

Prerequisites

Make sure NFS mounts are active. If NFS mounts are unresponsive, the operation fails.

Procedure

1 From the vSphere Client connected to a vCenter Server system, display the inventory.

2 (Optional) If the host is part of a cluster, you must put it in maintenance mode.

   a Right-click the managed host in the inventory and select **Enter Maintenance Mode** from the pop-up menu.

   b On the confirmation dialog, click **Yes**.

   The host icon changes and the term "maintenance mode" is added to the name in parentheses.

3 Right-click the appropriate host in the inventory panel, and select **Remove** from the pop-up menu.

4 In the confirmation dialog that appears, click **Yes** to remove the managed host.

vCenter Server removes the managed host and associated virtual machines from the vCenter Server environment. vCenter Server then returns the status of all associated processor and migration licenses to available.

Monitoring Host Health Status

You can use the vSphere Client to monitor the state of host hardware components, such as CPU processors, memory, fans, and other components.

The host health monitoring tool allows you to monitor the health of a variety of host hardware components including:

- CPU processors
- Memory
- Fans
- Temperature
- Voltage
- Power
- Network
- Battery
- Storage
- Cable/Interconnect
- Software components
- Watchdog
- Other

The host health monitoring tool presents data gathered using Systems Management Architecture for Server Hardware (SMASH) profiles. The information displayed depends on the sensors available on your server hardware.

You can monitor a host's health status either by connecting the vSphere Client directly to a host, or by connecting to a vCenter Server system. You can also set alarms to trigger when the host health status changes.

Monitor Health Status When Directly Connected to a Host

When you connect the vSphere Client directly to a host, you can view the health status from the host's **Configuration** tab.

When you are connected to a host through vCenter Server, you must use the **Hardware Status** tab to monitor the host health.

Procedure

1 Log in to the host using the vSphere Client, and display the inventory.

2 Click the **Configuration** tab, and click **Health Status**.

If a component is functioning normally, the status indicator is green. The status indicator changes to yellow or red if a system component violates a performance threshold or is not functioning properly. Generally, a yellow indicator signifies degraded performance. A red indicator signifies that a component stopped operating or exceeded the highest threshold. If the status is blank, then the health monitoring service cannot determine thae status of the component.

The **Reading** column displays the current values for the sensors. For instance, the column displays rotations per minute (RPM) for fans and degrees Celsius for temperature.

Monitor Health Status When Connected to vCenter Server

When you connect the vSphere Client to vCenter Server, you can view the health status from the **Hardware Status** tab.

When you are connected to a host through vCenter Server, you must use the **Hardware Status** tab to monitor the host health.

Prerequisites

To use the **Hardware Status** tab, you must enable vCenter Hardware Status plug-in.

Procedure

1 Log in to a vCenter Server system using the vSphere Client, and display the **Hosts and Clusters** view in the inventory.

2 Select the host in the inventory and click the **Hardware Status** tab.

3 From the **View** dropdown menu, select the type of information to view.

Option	Description
Sensors	Displays all sensors arranged in a tree view. If the status is blank, then the health monitoring service cannot determine the status of the component. ■ Click **Show all sensors** to expand the tree view to show all sensors under each group. ■ Click **Show all details** to expand the tree view to show descriptive details for every sensor. ■ Click **Hide all** to collapse the tree view to show only the sensor groups.
Alerts and warnings	Displays only alerts and warnings.
System event log	Displays the system event log. Click **Reset event log** to clear the event log.

Troubleshoot the Hardware Health Service

The Hardware Health service is a vCenter Server extension that uses an Internet Explorer Webbrowser control to display information about host hardware health. Use the information in this topic to troubleshoot problems with Hardware Health.

Procedure

- Take the appropriate action based on the observed problem.

Problem	Action
The Hardware Status tab is not visible in the vSphere Client.	Select **Plug-ins > Plug-in Manager** and verify that the Hardware Status plug-in is enabled.
The Hardware Status tab displays the following error message: `the remote name could not be resolved` *<SERVER–NAME>* where *<SERVER-NAME>* is the domain name of the vCenter Server system.	This error appears when the client system is unable to resolve the domain name of the vCenter Server system. Either fix the domain name resolution problem, or edit the file `C:\Program Files\VMware\Infrastructure\VirtualCenter Server\extensions\cim–ui\extensions.xml` on the vCenter Server system and replace the vCenter Server domain name with its IP address.
The Hardware Status tab displays a security alert.	Your Internet Explorer security settings are set too high. To change the security settings: a Launch Internet Explorer. b Select **Tools > Internet Options**. c Click the **Security** tab. d Select the **Local intranet** Web content zone. e Click **Custom Level**. f Underneath **Allow scripting of Internet Explorer Webbrowser control**, select **Enable**. g Click **OK** to close the Security Settings dialog box, and click **OK** to close the Internet Options dialog box.

Virtual Machine Management

Consolidating the Datacenter 8

VMware vCenter Guided Consolidation, recommended for smaller IT environments, enables you to streamline your datacenter by moving business applications, spread across multiple disparate physical systems, into a centrally managed virtual environment. Use the consolidation feature to start building your virtual environment, or to further consolidate your datacenter as it grows.

Multiple virtual machines can be hosted on a single physical system, enabling more efficient use of computing resources. Consolidating your datacenter involves the following process:

Find — You search for and select the physical systems in your datacenter that you want analyzed.

Analyze — Selected physical systems are analyzed and performance data on each selected system is collected. Generally, the longer the duration of the analysis phase, the higher the confidence in the vCenter Server's recommendations.

Consolidate — Performance data is compared to the resources available on the virtual machine host systems. The selected physical systems are converted to virtual machines and imported into vCenter Server on the recommended hosts where they are managed along with other components of your virtual environment.

Access the Guided Consolidation feature by clicking the **Consolidation** button.

This chapter includes the following topics:

- "Consolidation First Time Use," on page 90
- "Consolidation Prerequisites," on page 90
- "About Consolidation Services," on page 93
- "Configuring Consolidation Settings," on page 93
- "Find and Analyze Physical Systems," on page 94
- "Viewing Analysis Results," on page 95
- "Converting Physical Systems to Virtual Machines," on page 95
- "Viewing Consolidation Tasks," on page 96
- "Troubleshooting Consolidation," on page 97

Consolidation First Time Use

The first time you use the Consolidation feature, VMware recommends that you specify consolidation settings. These settings include default system credentials and active domains.

Default system credentials enable you to store a set of credentials so that you do not have to enter them each time you add systems for analysis. You can override default credentials when necessary.

Active domains enable you to register domains with the Consolidation feature. Active domains are scanned daily so that newly added systems are readily available.

Consolidation Prerequisites

Guided Consolidation requires that at least one host is managed through vSphere. It also requires that you provide credentials to the target physical systems.

Guided Consolidation can convert systems that are configured to any locale. Before you use the feature, ensure that the following prerequisites are met:

Guided Consolidation Server Host Requirements

Guided Consolidation server must be installed on a host that meets the following system requirements:

- Located within the company's network and have access to target systems for performance data collection.
- The Guided Consolidation host must have a name that can be resolved from any machine on the network
- The Guided Consolidation host must have a static IP address.
- Located in a domain and can access the Active Directory server.
- One of the following operating systems installed:
  - Windows 2003 Server SP2
  - Windows XP Professional SP3
  - Windows Server 2008 (Ensure that Computer Browser Windows Service is enabled)
  - Windows Vista (Ensure that Computer Browser Windows Service is enabled)
- .NET Framework 3.0 SP1 installed
- Windows Management Instrumentation (WMI) and Remote Registry installed, enabled, and running on host and all target systems
- Minimum 1000MHz CPU
- Minimum 1.8GB available RAM
- 3GB free disk space
- Authorized and able to connect to all the servers to be analyzed and consolidated using the protocols and ports listed in the section below, "Network Connections," on page 91.
- Access to general purpose ports that Windows uses for most of its communications for file/print sharing and authentication

General Requirements

- The following operating systems on systems targeted for analysis are supported:
  - Windows 2000 Professional/Server/Advanced
  - Windows XP Professional (32 bit and 64 bit)

  - Windows Server 2003 Standard/Web/Enterprise (32 bit and 64 bit)
  - Windows Vista (32 bit and 64 bit)
  - Windows Server 2008 (32 and 64 bit)
- Credentials with **Log on as service** privileges on the system where the Guided Consolidation server is installed must be provided at the time of installation. If Active Directory is deployed on your network, the provided credentials must also have sufficient privileges to query the Active Directory database.
- File and Printer Sharing must be enabled on the system where Guided Consolidation is installed and enabled on all systems targeted for analysis. Windows XP Simple File Sharing is insufficient.
- Guided Consolidation extension must be installed, enabled, and running on the vSphere Client.
- At least one datacenter inventory object exists.
- At least one host is registered with vCenter Server.
- Guided Consolidation requires administrator access to the systems selected for analysis. Specifically, the vCenter Collector Service uses these credentials to connect to and retrieve configuration and performance data from the physical systems under analysis. Accounts must be fully-qualified and can be any of the following:
  - account of the target system.
  - account of the target system domain.
  - account of a trusted domain of the target system.

Network Connections

The Guided Consolidation server must have access to the ports listed in the Table 8-1.

Table 8-1. Network Connections

Port	Protocol	Service	Description	MS Windows
135	TCP/UDP	Loc-srv/epmap	Microsoft DCE Locator service, also known as End-point Mapper.	DHCP Server DNS Server WINS Server
137	TCP/UDP	Netbios-ns	NetBIOS names service. Firewall administrators frequently see larger numbers of incoming packets to port 137. This is because of Windows servers that use NetBIOS (as well as DNS) to resolve IP addresses to names using the `gethostbyaddr()` function. As users behind the firewalls visit Windows-based Web sites, those servers frequently respond with NetBIOS lookups.	WINS Server DNS Server

Table 8-1. Network Connections (Continued)

Port	Protocol	Service	Description	MS Windows
138	TCP/UDP	Netbios-dgm	NetBIOS datagram Used by Windows, as well as UNIX services (such as SAMBA). Port 138 is used primarily by the SMB browser service that obtains Network Neighborhood information.	
139	TCP/UDP	Netbios-ssn	NetBIOS Session Windows File and Printer sharing.	
445	TCP/UDP	DNS	DNS Direct Hosting port. In Windows 2000 and Windows XP, redirector and server components now support direct hosting for communicating with other computers running Windows 2000 or Windows XP. Direct hosting does not use NetBIOS for name resolution. DNS is used for name resolution, and the Microsoft networking communication is sent directly over TCP without a NetBIOS header. Direct hosting over TCP/IP uses TCP and UDP port 445 instead of the NetBIOS session TCP port 139.	Active Directory

About Consolidation Services

Guided Consolidation can be installed together with vCenter Server, or can be installed on a separate host. For best performance, install Guided Consolidation on a separate host.

Guided Consolidation include the following services:

vCenter Collector Service	Discovers domains and systems within domains. Collects performance data on those systems.
vCenter Provider Service	Helper service to vCenter Collector Service. Communicates with target systems and passes the data back to vCenter Collector Service.
vCenter Guided Consolidation	Coordinates all communication among Guided Consolidation components. Saves the performance data collected by the vCenter Collector Service. Analyzes the data and generates placement recommendations. Also communicates with vCenter Server to perform conversion. Runs inside a generic servlet container labeled **VMware vCenter Management Webservices**. The services of other vCenter features and extensions might also be present inside that servlet container.

Configuring Consolidation Settings

It is recommended that you specify Consolidation settings before using the feature. Consolidation settings are located in the Configuration tab of the Guided Consolidation section of the vSphere Client.

The **Configuration** tab displays name, location, and health of Consolidation services. It also enables you to configure the following settings:

Default system credentials	Used by Guided Consolidation to access target physical systems. If necessary, the default credentials can be overridden.
Active Domains	Guided Consolidation automatically scans active domains and caches information about the systems in them. This information is updated daily. If you intend to add systems for analysis by selecting them from a domain, you must specify the domain as Active.

Specify Default Credentials

Default credentials are used to access systems selected for analysis when no other administrator credentials are specified.

Procedure

1 Click **Change** in the Default System Credentials area of the **Configuration** tab.

2 Enter a domain-qualified user name and password.

For example: *DOMAIN\username*.

3 Confirm the password and click **OK**.

Specify Active Domains

Specifying a domain as Active populates the Add to Analysis dialog box with a list of systems on that domain. That information is updated daily as long as the domain remains active.

VMware recommends that you leave domains where new systems are frequently added as Active and that you remove domains that do not frequently change after their information has been cached. Because scanning active domains is resource intensive, VMware also recommends that no more than 50 domains are simultaneously active.

NOTE In some cases it can take the system several hours to collect a domain's containment information.

Procedure

1 From the vSphere Client Home page, select **Guided Consolidation > Configuration**.

2 Click **Add** in the Active Domains section.

3 Select the domains you want to make active.

4 Click **OK**.

Find and Analyze Physical Systems

The Add to Analysis dialog box enables you to find systems in your environment and add them for analysis, to manually search for physical systems, or to select systems from the list of systems found in active domains. You can select systems and add them for analysis.

You can add systems manually by entering a computer name, IP address or range of IP addresses, or file name. Alternatively, you can select a domain - it must be active - and select systems found within that domain. You can analyze up to 100 systems simultaneously.

NOTE After adding a system for analysis, it can take up to one hour before the status of the newly added system changes from Collecting System Information to Analyzing.

Procedure

1 In the **Analysis** tab, click **Add to Analysis**.

2 Specify the systems you want to analyze.

Option	Description
Manually specify the computers	Provide computer names, IP addresses, a range of IP addresses, or path to a file that contains the computer names or IP addresses of the systems you want according to the following rules: ■ Separate multiple computer names, or IP address, with a comma. ■ Multiple IP ranges are not permitted. ■ If you chose to use a file, each computer name or IP address must be on a separate line in the file. The file must be accessible to the vSphere Client.
Select the computers by domains	Select the systems you want to analyze.

3 Click **Add to Analysis**.

4 Select whether you want to use the configured default credentials, or whether you want to supply a different set of credentials.

If you chose to override the default credentials, ensure that you enter a domain-qualified user name (for example, *DOMAIN\username*) and password.

5 Click **OK**.

Viewing Analysis Results

Analysis results are displayed in the **Analysis** tab.

When analysis is complete, the following information appears:

- **Physical Computer**– Displays the host name of the physical system being analyzed or imported.
- **CPU Info**– Displays the number of CPUs and their clock speed.
- **Memory Info**– Displays the amount of RAM on the system.
- **Status** – Displays the progress of the analysis.
- **Confidence** – Indicates the degree to which vCenter Server is able to gather performance data about the system and how good a candidate the system is based on the available data.
- **CPU Usage** – Displays the system's average CPU usage over time.
- **Memory Usage** – Displays the system's average memory usage over time.

About the Confidence Metric

One important metric displayed in the **Analysis** tab is the Confidence metric. During the analysis phase, performance data about each selected system is collected. This data is used to find a host with resources that match the collected data to determine a recommendation for each candidate.

The recommendation indicates how well suited, based on the collected data, a candidate is to a particular virtual machine host system. Confidence refers to the reliability of the recommendation and it is a function of the duration of the analysis. Recommendations based on longer periods of analysis – and therefore more performance data – receive a higher level of confidence.

NOTE After 24 hours of analysis, vCenter Server indicates a high level of confidence in its recommendations. However, this can be misleading if a system's workload varies significantly over weeks or months. To ensure a high level of confidence in a recommendation, allow the duration of the analysis phase to encompass an amount of time that includes representative peaks and troughs in the systems' workload. Analysis can run up to one month.

Converting Physical Systems to Virtual Machines

You can convert systems using auto-generated recommendations, or you can manually specify conversion parameters.

About Disk Resizing

During the conversion process, physical disks are typically resized to conserve space on the datastore while providing room for growth on the resultant virtual disk.

The following formula is used to resize converted disks:

```
amount of space used on physical disk * 1.25 = resultant virtual disk size
```

Virtual disks are set to a size of 4GB or larger.

Convert Systems Manually

You can convert systems manually if you want to specify values other than the default values for the resultant virtual machine's properties.

The option to convert systems manually is available only if the VMware Converter Enterprise Client is installed and enabled on your vSphere Client. You can verify whether VMware Converter Enterprise Client is installed and enabled through the Plug-in Manager.

Procedure

1 In the **Analysis** tab, right-click on a system and select **Convert to Virtual Machine > Manually**.

2 Complete the wizard to manually specify virtual machine properties.

Convert Systems Using Recommendations

Guided Consolidation recommendations are based on collected performance data and the capacity of available hosts.

Procedure

1 In the **Analysis** tab, select the systems you want to consolidate and click **Plan Consolidation**.

2 Select a system.

3 (Optional) Change the name displayed in the **Physical Computer** column by double-clicking it and entering a new name.

Your entry will be used as the name for the resultant virtual machine.

4 (Optional) Change destinations, if alternative destinations are available, by clicking in the **Destinations** column and selecting a destination from the drop-down menu.

The number of stars displayed in the **Destination Rating** column indicate the degree to which the host system can comfortably accommodate the estimated resource needs of the resultant virtual machine.

5 Click **Consolidate**.

A conversion task is instantiated.

What to do next

You can view task progress in the Recent Tasks pane. You view additional information about the task in the **Tasks** tab.

Viewing Consolidation Tasks

A task is created for each system being converted.

Recent tasks are displayed in the Recent Tasks pane. The **Tasks** tab lists all consolidation tasks. You can view detailed information about a task by selecting it. Information about events related to the selected task are displayed in the Task Details pane.

You can filter the list of tasks by entering criteria in the search field and selecting any combination of the following:

- Name
- Target
- Status
- Initiated by

- Start Time
- Complete Time

Troubleshooting Consolidation

The topics in this section contain information about identifying and solving problems with Guided Consolidation.

Negative Impact on vCenter Server Performance

Analyzing many systems simultaneously can impact vCenter Server performance.

Problem

Although up to 100 systems can be simultaneously analyzed, you might notice performance issues on the vCenter Server that are due to running Guided Consolidation.

Cause

Analysis is resource intensive and can negatively impact vCenter Server performance.

Solution

Reduce the number of systems that are being analyzed. If necessary, you can either disable Guided Consolidation or uninstall the Guided Consolidation Service. If you disable Guided Consolidation, collected data is preserved and no further data is collected. If you uninstall the Guided Consolidation Service, the data that has been collected will no longer be usable.

Windows Systems Not Discovered

Guided Consolidation does not discover some Windows systems.

Problem

Windows systems that match all of the following conditions will not be discovered by Guided Consolidation and will not be listed as candidates for analysis:

- The system is not listed in Microsoft Windows Network. The following commands do not list the system:

  ```
  NET VIEW
  NET VIEW /DOMAIN:<the Workgroup or Domain the system belongs to>
  ```

- The system is listed in Active Directory but does not have the `operatingSystem` attribute defined. This can happen if the system never synchronizes with the Active Directory to which it belongs or was improperly configured.

Solution

- Enable the **Computer Browser** service on the machine where Guided Consolidation is installed and on the systems that are not discovered.
- Ensure that the **Log On As** credentials for VMware vCenter Collector Provider Service met the prerequisites as mentioned in "Consolidation Prerequisites," on page 90.
- Manually enter the static IP address of the target system.

Windows Operating Systems Prevent Guided Consolidation from Collecting Performance Data

Guided Consolidation cannot collect performance data.

Problem

The default settings for some configurations of Windows XP, Windows Vista, and Windows Server 2008 prevent Guided Consolidation from collecting performance data against systems with those operating systems.

- The system is not listed in Microsoft Windows Network. The following commands do not list the system:

  ```
  NET VIEW
  NET VIEW /DOMAIN:<the Workgroup or Domain the system belongs to>
  ```

- The system is listed in Active Directory but does not have the `operatingSystem` attribute defined. This can happen if the system never synchronizes with the Active Directory to which it belongs or was improperly configured.

Solution

1. Set the Guided Consolidation target systems' **Network access: Sharing and security model for local accounts** option to **Classic - local users authenticate as themselves**
2. Select **Start > Run**.
3. Run either `gpedit.msc` or `secpol.msc`
4. In the left pane, select one of the following depending on which command you ran in the previous step:
   a. (gpedit.msc)**Local Computer Policy > Computer Configuration > Windows Settings > Security Settings > Local Policies > Security Options**
   b. (secpol.msc) **Security Settings > Local Policies > Security Options > Double-click on Network access: Sharing and security model for local accounts.**
   c. Double-click on **Network access: Sharing and security model for local accounts**. Ensure that **Classic - local users authenticate as themselves** is selected.
5. Ensure the changed settings are applied.
   - Restart VMware vCenter Collector Provider Service.
   - Run `gpupdate /force`.
   - Reboot the Guided Consolidation host system.

Available Domains List Remains Empty

Analyzing many systems simultaneously can impact vCenter Server performance.

Problem

The list of available domains remains empty for Guided Consolidation installed on Windows Server 2008 and Windows Vista.

Cause

Some configurations of Windows Vista and Windows Server 2008 prevent Guided Consolidation from discovering LAN Manager Workgroups. The Link-layer discovery protocol (LLDP), introduced in Windows 2008 Server, is not backward compatible with LAN Manager-based protocols and can not discover machines with earlier operating systems if those systems do not have the appropriate drivers installed. Additionally, Guided Consolidation does not use LLDP to perform discovery and will not find systems that can only be discovered through that protocol, or when the Computer Browser Windows Service is not running.

Solution

Ensure that the Computer Browser Windows Service is enabled on the Windows Vista or Windows Server 2008 system where Guided Consolidation is installed and that it is also enabled on all systems to be discovered. Alternatively, manually enter the static IP address of the system to be analyzed.

Guided Consolidation Erroneously Reports Analysis Disabled

Under some conditions, temporary network errors can disable analysis on multiple systems.

Problem

Temporary network errors can sometimes cause Guided Consolidation to stop analysis on one or more systems, even when the systems are reachable.

Solution

Right-click on the affected systems and select **Resume Analysis**.

Disable Guided Consolidation

You can disable Guided Consolidation.

Procedure

1 On the Guided Consolidation host system, open the Services control panel.

2 Stop the**VMware vCenter Management Webservices** (applicable when Guided Consolidation and vCenter Server are not collocated), the **VMware Collector for vCenter**, and the **VMware Provider for vCenter** services.

Uninstall Guided Consolidation

Uninstall Guided Consolidation to completely remove the feature. All collected data is also removed.

Procedure

1 Open the Add or Remove Programs control panel.

2 Remove **vCenter Guided Consolidation for vCenter Server**.

All vCenter Guided Consolidation services are removed.

CAUTION Do not uninstall the vCenter Collector Service alone. Doing so prevents Guided Consolidation from operating and will require that you perform a clean installation of Guided Consolidation, which will delete existing Guided Consolidation data.

9 Deploying OVF Templates

The VMware vSphere Client (vSphere Client) allows you to import and export virtual machines, virtual appliances, and vApps stored in Open Virtual Machine Format (OVF). An appliance is a pre-configured virtual machine that typically includes a preinstalled guest operating system and other software.

Deploying an OVF template allows you to add pre-configured virtual machines to your vCenter Server or ESX/ESXi inventory. Deploying an OVF template is similar to deploying a virtual machine from a template. However, you can deploy an OVF template from any local file system accessible from the vSphere Client machine, or from a remote web server. The local file systems can include local disks (such as C:), removable media (such as CDs or USB keychain drives), and shared network drives.

Exporting OVF templates allows you to create virtual appliances that can be imported by other users. You can use the export function to distribute pre-installed software as a virtual appliance, or as a means of distributing template virtual machines to users, including users who cannot directly access and use the templates in your vCenter Server inventory.

This chapter includes the following topics:

- "About OVF," on page 101
- "Deploy an OVF Template," on page 101
- "Browse VMware Virtual Appliance Marketplace," on page 103
- "Export an OVF Template," on page 103

About OVF

OVF is a file format that allows for exchange of virtual appliances across products and platforms.

The OVF format offers the following advantages:

- OVF files are compressed, allowing for faster downloads.
- The vSphere Client validates an OVF file before importing it, and ensures that it is compatible with the intended destination server. If the appliance is incompatible with the selected host, it cannot be imported and an error message appears.

Deploy an OVF Template

You can deploy an OVF template from a local file system accessible to the vSphere Client machine, or from a web URL.

NOTE To import a virtual machine that was created by another VMware product and is not in OVF format, use the VMware vCenter Converter module. See the VMware Converter Enterprise for vCenter Server documentation for more information.

Procedure

1 In the vSphere Client, select **File > Deploy OVF Template**.

The Deploy OVF Template wizard appears.

2 Specify the source location and click **Next**.

Option	Description
Deploy from File	Browse your file system for an OVF or OVA template.
Deploy from URL	Specify a URL to an OVF template located on the internet. Example: `http://vmware.com/VMTN/appliance.ovf`

3 View the OVF Template Details page and click **Next**.

4 If license agreements are packaged with the OVF template, the End User License Agreement page appears. Agree to accept the terms of the licenses and click **Next**.

5 (Optional) Edit the name and select the folder location within the inventory where the vApp will reside. Click **Next**.

NOTE When the vSphere Client is connected directly to an ESX/ESXi host, the option to select the folder location does not appear.

6 Select the deployment configuration from the drop-down menu and click **Next**.

The option selected typically controls the memory settings, number of CPUs and reservations, and application-level configuration parameters.

NOTE This page of the wizard is only shown if the OVF template contains deployment options.

7 Select the host or cluster on which you want to deploy the OVF template and click **Next**.

8 Select the host on which you want to run the deployed OVF template, and click **Next**.

This page is only shown if the destination is a resource pool associated with a cluster with DRS disabled or in manual mode.

9 Navigate to, and select the resource pool where you want to run the OVF template and click **Next**.

This page is only displayed if the cluster contains a resource pool.

10 Select a datastore to store the OVF template file, and click **Next**.

Datastores are a unifying abstraction for storage locations such as Fibre Channel, iSCSI LUNs, or NAS volumes. On this page, you select from datastores already configured on the destination cluster or host. The virtual machine configuration file and virtual disk files are stored on the datastore. Select a datastore large enough to accommodate the virtual machine and all of its virtual disk files.

11 For each network specified in the OVF template, select a network by right-clicking the **Destination Network** column in your infrastructure to set up the network mapping and click **Next**.

12 On the **IP Allocation** page, configure how IP addresses are allocated for the virtual appliance and click **Next**.

Option	Description
Fixed	You will be prompted to enter the IP addresses in the **Appliance Properties** page.
Transient	IP addresses are allocated from a specified range when the appliance is powered on. The IP addresses are released when the appliance is powered off.
DHCP	A DHCP server is used to allocate the IP addresses.

This page is not shown if the deployed OVF template does not contain information about the IP scheme it supports.

13 Set the user-configurable properties and click **Next**.

The set of properties that you are prompted to enter depend on the selected IP allocation scheme. For example, you are prompted for IP related information for the deployed virtual machines only in the case of a fixed IP allocation scheme.

14 Review your settings and click **Finish**.

The progress of the import task appears in the vSphere Client Status panel.

Browse VMware Virtual Appliance Marketplace

Available vApps appear in the main panel.

To get to the Virtual Appliance Marketplace page, select **File > Browse VA Marketplace** from the main menu.

Procedure

- Select an available vApp and click **Download Now**.

The OVF Template Details page appears.

Export an OVF Template

You can export a virtual machine, virtual appliance, or vApp to OVF format to make it available to other users to import into their inventory.

Procedure

1 Select the virtual machine or vApp and select **File > Export > Export OVF Template**.

2 In the Export OVF Template dialog, perform the following steps:

a Type the **Name** of the template.

For example, type `MyVm`

NOTE When exporting an OVF template with a name that contain asterisk (*) characters, those characters turn into underscore characters (_).

b Enter the **Directory** location where the exported virtual machine template is saved, or click "..." to browse for the location.

For example, `C:\OvfLib\`.

c In the **Optimized for** field, determine how you want to store the files.

Select **Web (OVF)** to store the OVF template as a set of files (`.ovf`, `.vmdk`, and `.mf`) This format is optimal if you plan to publish the OVF files on a web server or image library. The package can be imported, for example, into the vSphere client by publishing the URL to the `.ovf` file.

Select **Physical Media (OVA)** to package the OVF template into a single `.ova` file. This might be convenient to distribute the OVF package as a single file if it needs to be explicitly downloaded from a web site or moved around using a USB key.

d (Optional) To create a new folder for the OVF file, select the **Create folder for OVF template** checkbox.

For example, the following files might be created:

- `C:\OvfLib\MyVm\MyVm.ovf`
- `C:\OvfLib\MyVm.mf`
- `C:\OvfLib\MyVm-disk1.vmdk`

e (Optional) In **Description**, type a description for the virtual machine.

By default, the text from the **Notes** pane on the virtual machine's **Summary** tab appears in this text box.

The download process is shown in the Export window.

Managing VMware vApp 10

You can use VMware vSphere as a platform for running applications, in addition to using it as a platform for running virtual machines. The applications can be packaged to run directly on top of VMware vSphere. The format of how the applications are packaged and managed is called VMware® vApp.

A vApp is a container, like a resource pool and can contain one or more virtual machines. In addition, a vApp also shares some functionality with virtual machines. A vApp can power on and power off, and can also be cloned.

In the vSphere client, a vApp is both represented in the Host and Clusters view and the VM and Template view. Each view has a specific summary page with the current status of the service and relevant summary information, as well as operations on the service.

NOTE The vApp metadata resides in the vCenter Server's database, so a vApp can be distributed across multiple ESX/ESXi hosts. This information can be lost if the vCenter Server database is cleared or if a standalone ESX/ESXi host that contains a vApp is removed from vCenter Server. You should back up vApps to an OVF package in order to avoid losing any metadata.

The distribution format for vApp is OVF.

This chapter includes the following topics:

- "Create a vApp," on page 105
- "Populate the vApp," on page 107
- "Edit vApp Settings," on page 108
- "Configuring IP Pools," on page 111
- "Clone a vApp," on page 113
- "Power On a vApp," on page 113
- "Power Off a vApp," on page 114
- "Edit vApp Annotation," on page 114

Create a vApp

After you create a datacenter and add a clustered DRS-enabled host to your vCenter Server system, you can create a vApp.

You may create a new vApp under the following conditions:

- A host is selected in the inventory that is running ESX 3.0 or greater.

- A DRS-enabled cluster is selected in the inventory.

vApps can be created on folders, hosts, resource pools, DRS-enabled clusters, and within other vApps.

Procedure

1 Start the New vApp Wizard on page 106
The New vApp wizard allows you to create a new vApp.

2 Name the vApp on page 106
The name you enter is used as the vApp's display name in the inventory.

3 Select the vApp Destination on page 106
The destination is the host, cluster, resource pool, or vApp on which the vApp will run.

4 Allocate vApp Resources on page 107
Determine how much CPU and memory should be allocated for the vApp.

5 Complete the vApp Creation on page 107
The Ready to Complete page enables you to review the vApp's configuration.

Start the New vApp Wizard

The New vApp wizard allows you to create a new vApp.

Procedure

- Select **File > New > vApp** to open the New vApp wizard.

Name the vApp

The name you enter is used as the vApp's display name in the inventory.

The name can be up to 80 characters long. This name must be unique within the folder. .

Procedure

1 On the Name and Folder page, enter a name for the vApp.

2 Select a location in the inventory for the vApp.

If you are creating a vApp from within another vApp, the vApp Inventory Location selection is unavailable.

3 Click **Next**.

Select the vApp Destination

The destination is the host, cluster, resource pool, or vApp on which the vApp will run.

NOTE This step does not appear if you create a vApp from a host, cluster, resource pool, or another vApp within the inventory.

Procedure

1 On the Destination page, select a host, cluster, or resource pool where this vApp will run and click **Next**.

If you selected a DRS-enabled cluster and the cluster is in DRS manual mode, select the host as the destination for the vApp.

The message in the Compatibility panel indicates whether the validation for this destination succeeded or if a specific requirement was not met.

2 Click **Next**.

Allocate vApp Resources

Determine how much CPU and memory should be allocated for the vApp.

Procedure

1 In the Resource Allocation page, allocate CPU and memory resources for this vApp.

2 Click **Next**.

Complete the vApp Creation

The Ready to Complete page enables you to review the vApp's configuration.

Procedure

1 Review the new vApp settings on the Ready to Complete page.

2 (Optional) Click **Back** to edit or change any settings.

3 Click **Finish** to create the new vApp.

Populate the vApp

Virtual machines and other vApps can be added to and removed from a vApp.

Once a vApp is created, you can populate it with virtual machines or another vApp.

Create an Object Inside the vApp

Within a vApp, you can create a new virtual machine, resource pool, or another vApp.

Procedure

1 In the inventory, select the vApp in which you want to create the object machine.

2 Select the menu option to create a specific object.

Option	Description
Inventory > vApp > New Virtual Machine	Creates a new virtual machine inside the vApp. Complete the Create New Virtual Machine wizard. See Chapter 11, "Creating Virtual Machines," on page 115 for instructions on creating a new virtual machine.
Inventory > vApp > New Resource Pool	Adds a resource pool inside the vApp. Complete the Create Resource Pool window. See "Add a Cluster, Resource Pool, Host, or Virtual Machine," on page 73 for instructions on adding a new resource pool.
Inventory > vApp > New vApp	Creates a new vApp inside the currently selected vApp. Complete the New vApp wizard. See "Create a vApp," on page 105 for instructions on creating a new vApp.

The new object appears as part of the vApp in the inventory.

Add an Object to a vApp

You can add an object, such as a virtual machine or another vApp, to an existing vApp.

An existing virtual machine or another vApp that is not already contained inside the vApp can be moved into the currently selected vApp.

Procedure

1 Display the object in the inventory.

2 Click and drag the object to the target object.

- If the move is permitted, a box appears around the target-object, indicating it is selected.
- If move is not permitted, a naught sign (zero with a slash) appears, and the object is not moved.

3 Release the mouse button.

Either the object moves to the new location or an error message indicates what needs to be done to permit the move.

Edit vApp Settings

You can edit and configure several aspects of a vApp, including startup order, resources, and custom properties.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click the **Options** tab to edit or view the following vApp properties.

NOTE The IP allocation policy and properties are typically edited by the deployer, while the rest of the settings are more advanced options typically edited by the vApp author.

3 Click the **Start Up** tab to edit vApp startup and shutdown options.

4 Click **OK** when finished.

Edit vApp Startup and Shutdown Options

You can change the order in which virtual machines within a vApp start up and shut down. You can also specify delays and actions performed at startup and shutdown.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 In the **Start Order** tab of the **Edit Service Settings** window, select a virtual machine and use the arrow keys to change the startup order. This order will also be used for shutdown.

3 Specify the delay and action for startup and shutdown for each virtual machine.

4 Click **OK** when finished.

Edit vApp Resources

You can edit the CPU and memory resource allocation for the vApp.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **Resources** in the **Options** list.

3 Edit the CPU and memory resource allocation.

4 Click **OK** when finished.

Edit vApp Properties

You can edit any vApp property that is defined in Advanced Property Configuration.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **Properties** in the **Options** list.

3 Edit the vApp properties.

4 Click **OK** when finished.

View vApp License Agreement

You may view the license agreement for this vApp.

NOTE This option is only available if the vApp was imported and contains a license agreement.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **View License Agreement** in the **Options** list.

3 Click **OK** when finished.

Edit IP Allocation Policy

You can edit how IP addresses are allocated for the vApp.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **IP Allocation Policy** in the **Options** list.

3 Select one of the following options.

Option	Description
Fixed	IP addresses are manually configured. No automatic allocation is performed.
Transient	IP addresses are automatically allocated from a specified range when the appliance is powered on. The IP addresses are released when the appliance is powered off.
DHCP	A DHCP server is used to allocate the IP addresses. The addresses assigned by the DHCP server is visible in the OVF environments of virtual machines started in the vApp.

4 Click **OK** when finished.

View Additional OVF Sections

View additional OVF sections which are not recognized by vCenter Server.

These additional OVF sections originate from the OVF deployment process that created this vApp. Most of the OVF descriptors are distributed in various vApp settings, but these unrecognized sections are visible here for reference.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **View Additional OVF Sections** in the **Options** list.

3 Click **OK** when finished.

Configure Advanced vApp Properties

You can edit and configure advanced settings, such as product and vendor information, custom properties, and IP allocation.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **Advanced** in the **Options** list.

3 Specify the settings. The settings are displayed on the summary page of the virtual machine. The following settings can be set and configured:

- Product Name—the product name.
- Version—the version of the vApp.
- Full version—the full version of the vApp.
- Product URL—the product's URL. If a product URL is entered, a user can click the product name on the virtual machine summary page and go to the product's web page.
- Vendor URL—the vendor's URL. If a vendor URL is entered, a user can click the vendor name on the virtual machine summary page and go to the vendor's web page.
- Application URL—the application URL. If properties are used for specifying the virtual machine IP address, a dynamic application URL can be entered that points to a web page exposed by running the virtual machine. If you enter a valid application URL, the state of the virtual machine changes to a clickable **Available** link once the virtual machine is running.

If the virtual machine is configured to use the property called *webserver_ip* and the virtual machine has a web server, you can enter `http://${webserver_ip}/` as the **Application URL**.

4 Click View to test the **Product URL** and **Vendor URL**.

5 Click **Properties** to edit the custom vApp properties.

6 Click **IP Allocation** to edit the supported IP allocation schemes of this vApp.

7 Click **OK** when finished.

Define OVF Environment Properties

You can view or modify the OVF environment properties for the vApp.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **Advanced** in the **Options** list.

3 Edit the product information within the appropriate fields.

If permissions are set to read-only, the fields cannot be edited.

4 Click **Properties**.

5 In Advanced Property Configuration, you may perform the following actions.

- Click**New** to add a new custom property.
- Select the property and click **Edit** to edit a property.
- Click **Delete** to delete a property.

6 Click **OK** when finished.

Edit Advanced IP Allocation Properties

You can edit the IP allocation scheme for the vApp.

Procedure

1 On the Summary page of the vApp, click **Edit Settings**.

2 Click **Advanced** in the **Options** list.

3 Click **IP Allocation**.

4 In the Advanced IP Allocation dialog, you may perform the following actions.

- Select an IP allocation scheme.
- Specify the IP protocols supported by the vApp: IPv4, IPv6, or both.

5 Click **OK** when finished.

Configuring IP Pools

IP pools provide a network identity to vApps. An IP pool is a network configuration that is assigned to a network used by a vApp. The vApp can then leverage vCenter Server to automatically provide an IP configuration to its virtual machines.

Specify an IP Address Range

You can set up an IP address range by specifying a host address range within a network.

IP pool ranges are configured with IPv4 and IPv6. These ranges are used by vCenter Server to dynamically allocate IP addresses to virtual machines when a vApp is set up to use transient IP allocation.

Procedure

1 In the inventory, select the datacenter that contains the vApp.

2 On the **IP Pools** tab, right-click the IP pool you wish to edit and select **Properties**.

NOTE If no IP pools are present, click **Add** to add a new IP pool.

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3 In the Properties dialog, select the IPv4 or the IPv6 tab, depending on your IP protocol.

4 Specify the **IP Subnet** and **Gateway** in the respective fields.

5 (Optional) Select the **Enable IP Pool** check box.

You must enable this setting to specify an IP address range.

6 (Optional) Type a comma-separated list of host address ranges in the **Ranges** field.

A range is specified as an IP address, a pound sign (#), and a number indicating the length of the range.

The gateway and the ranges must be within the subnet, but must exclude the gateway address.

For example, **`10.20.60.4#10, 10.20.61.0#2`** indicates that the IPv4 addresses can range from 10.20.60.4 to 10.20.60.13 and 10.20.61.0 to 10.20.61.1.

7 Click **OK** when finished.

Select DHCP

You can specify that an IPv4 or IPv6 DHCP server is available on the network.

Procedure

1 In the inventory, select the datacenter that contains the vApp.

2 In the IP Pools tab, right-click the IP pool you wish to edit and select **Properties**.

NOTE If no IP pools are present, click **Add** to add a new IP pool.

3 In the Properties dialog, select the DHCP tab.

4 Select either the **IPv4 DHCP Present** or **IPv6 DHCP Present** check box to indicate that one of the DHCP servers are available on this network.

5 Click **OK** when finished.

Specify DNS Settings

Specify the DNS settings for the vApp.

Procedure

1 In the inventory, select the datacenter that contains the vApp.

2 In the IP Pools tab, right-click the IP pool you wish to edit and select **Properties**.

NOTE If no IP pools are present, click **Add** to add a new IP pool.

3 In the Properties dialog, select the DNS tab.

4 Enter the DNS server information.

The servers are specified by IP addresses separated by a comma, semi-colon, or space.

The DNS information that can be set include:

- DNS Domain
- Host Prefix
- DNS Search Path
- IPv4 DNS Servers
- IPv6 DNS Servers

5 Click **OK** when finished.

Specify a Proxy Server

Specify a proxy server for the vApp.

Procedure

1 In the inventory, select the datacenter that contains the vApp.

2 In the IP Pools tab, right-click the IP pool you wish to edit and select **Properties**.

NOTE If no IP pools are present, click **Add** to add a new IP pool.

3 In the Properties dialog, select the Proxy tab.

4 Enter the server name and port number for the proxy server.

The server name can optionally include a colon and a port number.

For example, `web-proxy:3912` is a valid proxy server.

5 Click **OK** when finished.

Clone a vApp

Cloning a vApp is similar to cloning a virtual machine.

Prerequisites

To clone a vApp, the vSphere Client must be connected to the vCenter Server system.

A host must be selected in the inventory that is running ESX 3.0 or greater, or a DRS-enabled cluster.

Procedure

1 Select the vApp in the inventory.

2 Select **Inventory > vApp > Clone**

Complete each page in Clone vApp the wizard.

3 Select the vApp destination and click **Next**.

4 Specify a Host and click **Next**.

NOTE This step is only available if you select a cluster that is in DRS manual mode.

5 Name the vApp and click **Next**.

6 Select a datastore and click **Next**.

7 (Optional) Select a network and click **Next**.

8 Complete the vApp clone.

Power On a vApp

Each application within the service will be powered on according to how the startup order is set.

When powering on a vApp within a DRS cluster in manual mode, no DRS recommendations are generated for virtual machine placements. The power on operation performs as if DRS is run in a semi-automatic or automatic mode for the initial placements of the virtual machines. This does not affect VMotion recommendations. Recommendations for individual powering on and powering off of virtual machines are also generated for vApps that are running.

Procedure

- In the Summary page for the service, click **Power On**.

  If a delay is set in the start up settings, the vApp waits for the set length of time before powering up that virtual machine.

In the **Summary** tab, the status indicates when the vApp has started and is available. Links to the product and vendor Web sites are also found under General.

Power Off a vApp

Each application within the service will be powered off according to how the shutdown order is set.

Procedure

- In the Summary page for the service, click **Power Off**.

  If a delay is set in the shutdown settings, the vApp waits for the set length of time before powering down that virtual machine.

Edit vApp Annotation

You can add or edit notes for a particular vApp.

Procedure

1. Select the vApp in the inventory.
2. Click the **Summary** tab for the vApp.
3. In the Annotations box, click **Edit**.
4. Enter text in the Edit Service Annotation window.
5. Click **OK**.

11 Creating Virtual Machines

This section discusses how to create virtual machines through the New Virtual Machine Wizard.

This chapter includes the following topics:

- "Access the New Virtual Machine Wizard," on page 115
- "Select a Path Through the New Virtual Machine Wizard," on page 116
- "Enter a Name and Location," on page 116
- "Select a Resource Pool," on page 116
- "Select a Datastore," on page 117
- "Select a Virtual Machine Version," on page 117
- "Select an Operating System," on page 117
- "Select the Number of Virtual Processors," on page 117
- "Configure Virtual Memory," on page 118
- "Configure Networks," on page 118
- "About VMware Paravirtual SCSI Adapters," on page 118
- "Select a SCSI Adapter," on page 119
- "Selecting a Virtual Disk Type," on page 119
- "Complete Virtual Machine Creation," on page 122
- "Installing a Guest Operating System," on page 122
- "Installing and Upgrading VMware Tools," on page 123

Access the New Virtual Machine Wizard

Use the New Virtual Machine Wizard to create a new virtual machine.

Procedure

1 In the vSphere Client, select one of the following objects.

- Resource pools
- Clusters
- Hosts
- Virtual machine folders

2 Select **File > New > Virtual Machine**.

Select a Path Through the New Virtual Machine Wizard

You can create a new virtual machine using the common default settings or customize the options.

The **Typical** path shortens the process by skipping some choices that rarely need changing from their defaults. This path includes the following steps.

1 "Enter a Name and Location," on page 116

2 "Select a Resource Pool," on page 116

3 "Select a Datastore," on page 117

4 "Select an Operating System," on page 117

5 "Create a Virtual Disk," on page 120

The **Custom** path provides more flexibility and options. This path includes the following steps.

1 "Enter a Name and Location," on page 116

2 "Select a Resource Pool," on page 116

3 "Select a Datastore," on page 117

4 "Select a Virtual Machine Version," on page 117

5 "Select an Operating System," on page 117

6 "Select the Number of Virtual Processors," on page 117

7 "Configure Virtual Memory," on page 118

8 "Configure Networks," on page 118

9 "Select a SCSI Adapter," on page 119

10 "Selecting a Virtual Disk Type," on page 119

Enter a Name and Location

The name you enter is used as the virtual machine's display name in the inventory. It is also used as the name of the virtual machine's files.

The name can be up to 80 characters long. This name must be unique within the folder. Names are case-insensitive: the name my_vm is identical to My_Vm.

Procedure

1 In the Name and Location screen of the New Virtual Machine wizard, enter a name.

2 Select a folder or the root of the datacenter.

3 Click **Next**.

Select a Resource Pool

The resource pool option is available when resource pools are configured on the host.

Procedure

1 Navigate to the resource pool where you want to run the virtual machine.

2 Select it and click **Next**.

Select a Datastore

Select a datastore that will contain the virtual machine and its virtual disk files.

For ESX/ESXi hosts, the datastores are configured on that host, including FC, NAS, and iSCSI volumes.

Procedure

- Select a datastore large enough to hold the virtual machine and all of its virtual disk files and click **Next**.

Select a Virtual Machine Version

If the host or cluster where you chose to locate the virtual machine supports more than one VMware virtual machine version, you have the option to select a version for your virtual machine.

Select one of the following versions:

- Virtual machine version 4 — Compatible with ESX 3.0 and greater hosts. Recommended for virtual machines that need to run on ESX 3.x hosts and for virtual machines that must share virtual hard disks with other version 4 virtual machines.
- Virtual machine version 7 — Compatible with ESX 4.0 and greater hosts. Provides greater virtual machine functionality. Recommended for virtual machines that do not need to migrate to ESX 3.x hosts.

Select an Operating System

The guest operating system you select affects the supported devices and number of virtual CPUs available for the virtual machine.

See the *Guest Operating System Installation Guide* for details.

The wizard does not install the guest operating system for you. The New Virtual Machine wizard uses this information to select appropriate default values, such as the amount of memory needed.

Procedure

1. Select one of the following operating system families:
   - Microsoft Windows
   - Linux
   - Novell NetWare
   - Solaris
   - Other
2. If you select **Other**, enter a display name for your operating system.

Select the Number of Virtual Processors

VMware Virtual SMP™ is required to power on multiprocessor virtual machines. The number of licensed CPUs on the host and the number of processors supported by the guest operating system limit the number of virtual processors you can create.

The Virtual CPUs page appears for multiprocessor hosts.

Procedure

- Select the number of processors from the drop-down menu.

Configure Virtual Memory

Select the virtual memory size on the Configure Virtual Memory page.

Minimum memory size is 4MB. Maximum memory size depends on the host. The memory size must be a multiple of 4MB. The maximum for best performance represents the threshold above which the host's physical memory is insufficient to run the virtual machine at full speed. This value fluctuates as conditions on the host change (as virtual machines are powered on or off, for example).

Procedure

- Select a size for the virtual memory by using the slider or by selecting the number using the up and down arrows.

Configure Networks

Select the number of NICs for the virtual machine on the Configure Networks page.

Exercise caution when you configure a virtual machine to connect to multiple networks. Because virtual machines share their physical network hardware with the host, the accidental or malicious bridging of two networks by a virtual machine can occur. Spanning Tree protocol cannot protect against these occurrences.

Procedure

1. Select the number of network interface cards (NICs) you want to create on the virtual machine.
2. For each NIC, select a network, adapter type, and whether you want the NIC to connect when the virtual machine is powered on.

About VMware Paravirtual SCSI Adapters

Paravirtual SCSI (PVSCSI) adapters are high-performance storage adapters that can result in greater throughput and lower CPU utilization. Paravirtual SCSI adapters are best suited for high performance storage environments. Paravirtual SCSI adapters are not suited for DAS environments.

Paravirtual SCSI adapters are available for virtual machines running hardware version 7 and greater. They are supported on the following guest operating systems:

- Windows Server 2008
- Windows Server 2003
- Red Hat Linux (RHEL) 5

The following features are not supported with Paravirtual SCSI adapters:

- on Linux
- Record/Replay
- Fault Tolerance
- MSCS Clustering

Paravirtual SCSI adapters have the following limitations:

- Hot-add and Hot-remove requires a bus rescan from within the guest.
  - (Windows guests) In the Computer Management console, right-click **Storage > Disk Management** and select **Rescan Disks**.
  - (Linux guests) See the Red Hat Linux Web site for the most current instructions.

- Disks on Paravirtual SCSI adapters might not experience performance gains if they have snapshots or if memory on the ESX host is over committed.
- If you upgrade from RHEL 5 to an unsupported kernel, you might not be able to access data on the disks attached to a Paravirtual SCSI adapter. To regain access to such disks, run the VMware Tools configuration (`vmware-config-tools.pl`) with kernel-version parameter and pass the kernel version after the kernel is upgraded and before the virtual machine is rebooted. Run `uname -r` to determine the version of the running kernel.

Select a SCSI Adapter

The Select SCSI Controller Type page enables you to select one of the following types of SCSI controllers. The choice of SCSI controller does not affect whether your virtual disk is an IDE or SCSI disk.

The IDE adapter is always ATAPI. The default for your guest operating system is already selected. Older guest operating systems default to the BusLogic adapter.

If you create an LSI Logic virtual machine and add a virtual disk that uses BusLogic adapters, the virtual machine boots from the BusLogic adapters disk. LSI Logic SAS is available only for virtual machines with hardware version 7. Disks with snapshots might not experience performance gains when used on LSI Logic SAS and LSI Logic Parallel adapters.

Procedure

- Choose one of the following SCSI controller types:
  - BusLogic Parallel
  - LSI Logic SAS
  - LSI Logic Parallel
  - VMware Paravirtual

Selecting a Virtual Disk Type

A virtual disk comprises one or more files on the file system that appear as a single hard disk to the guest operating system. These disks are portable among hosts.

You can select among the following options:

- "Create a Virtual Disk," on page 120
- "Use an Existing Virtual Disk," on page 120
- "Create Raw Device Mappings," on page 121
- "Do Not Create a Disk," on page 121

About Virtual Disk Formats

When you perform certain virtual machine management operations, such as create a virtual disk, clone a virtual machine to a template, or migrate a virtual machine, you can specify a format for the virtual disk file.

The following disk formats are supported. You cannot specify the disk format if the disk resides on an NFS datastore. The NFS server determines the allocation policy for the disk.

Thin Provisioned Format Use this format to save storage space. For the thin disk, you provision as much datastore space as the disk would require based on the value you enter for the disk size. However, the thin disk starts small and at first, uses only as much datastore space as the disk actually needs for its initial operations.

NOTE If a virtual disk supports clustering solutions such as Fault Tolerance, you cannot make the disk thin.

If the thin disk needs more space later, it can grow to its maximum capacity and occupy the entire datastore space provisioned to it. Also, you can manually convert the thin disk into thick.

Thick Format This is the default virtual disk format. The thick virtual disk does not change its size and from the very beginning occupies the entire datastore space provisioned to it. Thick format does not zero out the blocks in the allocated space. It is not possible to convert the thick disk into thin.

Create a Virtual Disk

When you create a new disk, you can specify disk properties such as size, format, clustering features, and more.

Procedure

1 Specify the size of the disk in Megabytes, Gigabytes, or Terabytes.

You can change the size of the disk later, and add additional disks Virtual Machine Properties dialog box.

2 (Optional) If you want your disk to be in thin format, select **Allocate and commit space on demand (Thin Provisioning)**.

3 (Optional) If you want to use clustering features, select **Support clustering features such as Fault Tolerance**.

4 Specify whether you want to store the virtual disk file on the same datastore as the virtual machine files, or whether you want to store them on a separate datastore.

Use an Existing Virtual Disk

You can use an existing virtual disk.

Procedure

1 Browse to a virtual disk file, and click **OK**.

2 (Optional) Configure advanced options:

- Select a virtual device node.
- Enable Independent mode and select whether you want changes to the disk to persist, or whether you want changes to be discarded when the virtual machine is powered off or reverted to a snapshot.

Create Raw Device Mappings

For virtual machines running on an ESX/ESXi host, instead of storing virtual machine data in a virtual disk file, you can store the data directly on a SAN LUN. This is useful if you are running applications in your virtual machines that must know the physical characteristics of the storage device. Additionally, mapping a SAN LUN allows you to use existing SAN commands to manage storage for the disk.

When you map a LUN to a VMFS volume, vCenter Server creates a file that points to the raw LUN. Encapsulating disk information in a file allows vCenter Server to lock the LUN so that only one virtual machine can write to it.

NOTE This file has a `.vmdk` extension, but the file contains only disk information describing the mapping to the LUN on the ESX/ESXi system. The actual data is stored on the LUN.

You cannot deploy a virtual machine from a template and store its data on a LUN. You can only store its data in a virtual disk file.

Procedure

1 Select a target LUN.

2 Select whether you want to store the LUN mapping file on the same datastore as the virtual machine files, or whether you want to store them on a separate datastore.

3 Select a datastore.

4 Select a compatibility mode.

5 (Optional) Configure advanced options by selecting a virtual device node.

Virtual Disk Compatibility Modes

Virtual disk compatibility modes provide flexibility in how Raw Device Mappings (RDM) function.

Virtual Compatibility Mode

Virtual mode for an RDM specifies full virtualization of the mapped device. It appears to the guest operating system exactly the same as a virtual disk file in a VMFS volume. The real hardware characteristics are hidden. Virtual mode enables you to use VMFS features such as advanced file locking and snapshots. Virtual mode is also more portable across storage hardware than physical mode, presenting the same behavior as a virtual disk file. When you clone the disk, make a template out of it, or migrate it (if the migration involves copying the disk), the contents of the LUN are copied into a virtual disk (`.vmdk`) file.

Physical Compatibility Mode

Physical mode for the RDM specifies minimal SCSI virtualization of the mapped device, allowing the greatest flexibility for SAN management software. In physical mode, the VMkernel passes all SCSI commands to the device, with one exception: the REPORT LUNs command is virtualized, so that the VMkernel can isolate the LUN for the owning virtual machine. Otherwise, all physical characteristics of the underlying hardware are exposed. Physical mode is useful to run SAN management agents or other SCSI target based software in the virtual machine. Physical mode also allows virtual-to-physical clustering for cost-effective high availability. LUNs attached to powered-on virtual machines and configured for physical compatibility cannot be migrated if the migration involves copying the disk. Such LUNs cannot be cloned or cloned to a template either.

Do Not Create a Disk

When you create a virtual machine, you can select not to create a virtual disk.

Select this option if you want to create a virtual machine without a disk, or if you want to add disks to the virtual machine later using the Virtual Machine Properties dialog box.

Procedure

- Select **Do not create a disk**.

Complete Virtual Machine Creation

The Ready to Complete page enables you to review your virtual machine's configuration.

To perform additional configuration before completing the virtual machine, select the **Edit the virtual machine settings before completion** check box and click **Next**.

Before you can use your new virtual machine, you must first partition and format the virtual drive, install a guest operating system, then install VMware Tools. Typically, the operating system's installation program handles partitioning and formatting the virtual drive.

Installing a Guest Operating System

Installing a guest operating system inside your virtual machine is essentially the same as installing it on a physical computer.

The basic steps for a typical operating system are described in this section. See *Guest Operating System Installation Guide* for more information on individual guest operating systems.

NOTE It might be necessary to change the boot order in the virtual machine's BIOS settings. However, sometimes a virtual machine's boot sequence progresses too quickly for a user to open a console to the virtual machine and enter BIOS setup. If this happens, select the **Boot Options** option on the **Options** tab of the Virtual Machine Properties dialog box, and select **The next time the virtual machine boots, force entry into the BIOS setup screen**. The virtual machine will enter the BIOS setup the next time it boots.

Using PXE with Virtual Machines

You can boot a virtual machine from a network device and remotely install a guest operating system using a preboot execution environment (PXE).

To do this, the virtual machine must meet the following requirements:

- Have a virtual disk without operating system software, and with enough free disk space to store the intended system software.
- Have a network adapter connected to the network where the PXE server resides. (see "Network Adapter Types," on page 162)
- BIOS must include the network adapter in the boot order.

NOTE vmnext3 adapters can enter neither UPT nor CDPT mode while booting from a PXE.

VMware has tested and supports the following PXE configurations with ESX Server:

- Remote installation of a Windows Server 2003 guest operating system from a server running Windows Server 2003 Automated Deployment Services
- Remote installation of a Windows 2000 guest operating system from a server running Windows 2000 Server/Advanced Server Remote Installation Services
- Remote installation of a Linux guest operating system from a Red Hat Enterprise Linux 3.0 AS PXE boot server
- Remote installation of a supported guest operating system from a Ghost image using Windows 2000 and Ghost RIS Boot package
- Remote installation of a supported guest operating system from an Altiris image using a Windows 2000 Altiris server

- Network booting a Linux virtual machine by connecting with the Linux Diskless option to a Red Hat Enterprise Linux 3.0 AS server

NOTE Server does not support installation of a Windows XP guest operating system using PXE.

Install a Guest Operating System from Media

You can install a guest operating system from ISO or CD-ROM.

Procedure

1. Using the vSphere Client, log into the vCenter Server system or host on which the virtual machine resides.
2. Insert the installation CD-ROM for your guest operating system, or create an ISO image file from the installation CD-ROM.

   Using an ISO image is faster than using a CD-ROM.
3. Use the Virtual Machine Settings editor to connect the virtual machine's CD-ROM drive to the ISO image file and power on the virtual machine.
4. To power on your virtual machine, click the **Power On** button.

   When a virtual machine is powered on, a green right arrow appears next to the virtual machine icon in the inventory list.
5. Follow the installation instructions provided by the operating system vendor.

Installing and Upgrading VMware Tools

VMware Tools is a suite of utilities that enhances the performance of the virtual machine's guest operating system and improves management of the virtual machine.

Installing VMware Tools in the guest operating system is vital. Although the guest operating system can run without VMware Tools, you lose important functionality and convenience.

When you install VMware Tools, you install:

- The VMware Tools service (`VMwareService.exe` on Windows guests or `vmware-guestd` on Linux and Solaris guests). This service synchronizes the time in the guest operating system with the time in the host operating system. On Windows guests, it also controls grabbing and releasing the mouse cursor.
- A set of VMware device drivers, including an SVGA display driver, the `vmxnet` networking driver for some guest operating systems, the BusLogic SCSI driver for some guest operating systems, the memory control driver for efficient memory allocation between virtual machines, the sync driver to quiesce I/O for Consolidated Backup, and the VMware mouse driver.
- The VMware Tools control panel, which lets you modify settings, shrink virtual disks, and connect and disconnect virtual devices.
- A set of scripts that helps you to automate guest operating system operations. The scripts run when the virtual machine's power state changes if you configure them to do so.
- The VMware user process (`VMwareUser.exe` on Windows guests or `vmware-user` on Linux and Solaris guests), which enables you to copy and paste text between the guest and managed host operating systems.

  On Linux and Solaris guests, this process controls grabbing and releasing the mouse cursor when the SVGA driver is not installed.

  The VMware Tools user process is not installed on NetWare operating systems. Instead, the `vmwtool` program is installed. It controls the grabbing and releasing of the mouse cursor. It also allows you copy and paste text.

You can optionally install WYSE Multimedia Redirector, which improves streaming video performance in Windows guest operating systems running on WYSE thin client devices.

The installers for VMware Tools for Windows, Linux, Solaris, and NetWare guest operating systems are built into ESX/ESXi as ISO image files. An ISO image file looks like a CD-ROM to your guest operating system and even appears as a CD-ROM disc in Windows Explorer. You do not use an actual CD-ROM disc to install VMware Tools, nor do you need to download the CD-ROM image or burn a physical CD-ROM of this image file.

When you choose to install VMware Tools, vCenter Server temporarily connects the virtual machine's first virtual CD-ROM disk drive to the ISO image file that contains the VMware Tools installer for your guest operating system. You are ready to begin the installation process.

Limitations

VMware Tools has the following limitations:

- Shrink disk is not supported.
- For Microsoft Windows NT, the default scripts for suspend and resume do not work.
- The mouse driver installation fails in X windows versions earlier than 4.2.0.

NOTE If you do not have VMware Tools installed in your virtual machine, you cannot use the shutdown or restart options. You can use only the Power options. If you want to shut down the guest operating system, shut it down from within the virtual machine console before you power off the virtual machine.

Install VMware Tools on a Windows Guest

Install the most recent version of VMware Tools to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

To determine the status of VMware Tools, select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

NOTE During VMware Tools installation, a Windows guest operating system might display a message indicating that the package has not been signed. If this message appears, click **Install Anyway** to continue the installation.

Prerequisites

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1. From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.
2. Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.
3. Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.
4. Select **Interactive Tools Installation** and click **OK.**

   This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.
5. If the New Hardware wizard appears, go through the wizard and accept the defaults.

6 In the virtual machine console, do one of the following.

- If autorun is enabled, click **OK** to confirm that you want to install VMware Tools and launch the InstallShield wizard.
- If autorun is not enabled, manually launch the VMware Tools installer by clicking **Start > Run** and entering `D:\setup.exe`, where `D:` is your first virtual CD-ROM drive.

7 Follow the onscreen instructions.

8 Reboot for the changes to take effect.

What to do next

- Verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.
- For Windows 2000 and later, VMware Tools installs the VmUpgradeHelper tool to restore the network configuration. From the Windows guest opertating system, start the VmUpgradeHelper service.

Install VMware Tools on a Linux Guest from the X Window System

Install the latest version of VMware Tools to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

Before you install or upgrade VMware Tools on a virtual machine, determine the status of VMware Tools. To do this, select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

Prerequisites

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1 From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.

2 Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.

3 Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.

4 Select **Interactive Tools Installation** and click **OK.**

This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.

5 Do one of the following:

- From the desktop, double-click the **VMware Tools CD** icon or the file manager window and double-click the RPM installer.
- If the VMware Tools CD icon or file manager window does not appear, install VMware Tools from the command line.

6 When prompted, enter the root password and click **OK**.

The installer prepares the packages.

7 Click **Continue** when the installer presents a dialog box that shows **Completed System Preparation**.

When the installer is done, VMware Tools is installed. There is no confirmation or finish button.

8 In a terminal window, as root (`su –`), run the following command to configure VMware Tools: `vmware-config-tools.pl`

Respond to the questions the installer displays on the screen. Press Enter to accept the default values if appropriate for your configuration.

9 Exit from the root account by issuing the `exit` command.

What to do next

Verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.

Install VMware Tools on a Linux Guest with the Tar Installer

Install the latest version of VMware Tools to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

Before you install or upgrade VMware Tools on a virtual machine, determine the status of VMware Tools. Select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

Prerequisites

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1 From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.

2 Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.

3 Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.

4 Select **Interactive Tools Installation** and click **OK.**

This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.

5 In the virtual machine console, log in as root (**`su –`**) and, if necessary, create the `/mnt/cdrom` directory:

```
mkdir /mnt/cdrom
```

6 Mount the VMware Tools virtual CD-ROM image.

Some Linux distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the `mount` and `umount` commands in this procedure.

Some Linux distributions use different device names or organize the `/dev` directory differently. Modify the following commands to reflect the conventions used by your distribution:

```
mount /dev/cdrom /mnt/cdrom
cd /tmp
```

7 Change to a working directory (for example, `/tmp`).

```
cd /tmp
```

8 If you have a previous installation, delete the previous `vmware-tools-distrib` directory.

```
rm –rf /tmp/vmware-tools-distrib
```

The default location of this directory is: `/tmp/vmware-tools-distrib`.

9 List the contents of the /mnt/cdrom/ directory, and note the filename of the VMware Tools tar installer.

```
ls /mnt/cdrom
```

10 Uncompress the tar installer.

```
tar zxpf /mnt/cdrom/VMwareTools-4.0.0-<xxxxxx>.tar.gz
```

Where <xxxxxx> is the build or revision number of the ESX/ESXi release.

If you attempt to install a tar installation over an RPM installation, the installer detects the previous installation and must convert the installer database format before continuing.

11 Unmount the CD-ROM image:

```
umount /dev/cdrom
```

12 Run the VMware Tools tar installer.

```
cd vmware-tools-distrib
```

```
./vmware-install.pl
```

For each configuration question, press Enter to accept the default value.

13 Log off the root account.

```
exit
```

What to do next

After you install or upgrade VMware Tools on a virtual machine, verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.

Install VMware Tools on a Linux Guest with the RPM Installer

Install VMware Tools to the latest version to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

Before you install or upgrade VMware Tools on a virtual machine, determine the status of VMware Tools. To do this, select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

NOTE RPM packages are not available with the ESXi installer. Only the tar package is available for ESXi hosts.

Prerequisites

The following items are prerequisites for completing this procedure:

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1 From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.

2 Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.

3 Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.

4 Select **Interactive Tools Installation** and click **OK.**

This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.

5 In the virtual machine console, log in as root (**su –**) and, if necessary, create the /mnt/cdrom directory:

```
mkdir /mnt/cdrom
```

6 Mount the VMware Tools virtual CD-ROM image.

Some Linux distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the mount and umount commands in this procedure.

Some Linux distributions use different device names or organize the /dev directory differently. Modify the following commands to reflect the conventions used by your distribution:

```
mount /dev/cdrom /mnt/cdrom
cd /tmp
```

7 Change to a working directory (for example, /tmp):

```
cd /tmp
```

8 If you have a previous installation, delete the previous vmware-tools-distrib directory:

```
rm -rf /tmp/vmware-tools-distrib
```

The default location of this directory is: /tmp/vmware-tools-distrib.

9 List the contents of the /mnt/cdrom/ directory, and note the filename of the VMware Tools rpm installer:

```
ls /mnt/cdrom
```

10 Install or upgrade the RPM package.

```
rpm -Uhv /mnt/cdrom/VMwareTools-4.0.0-<xxxxxx>.i386.rpm
```

Where <xxxxxx> is the build or revision number of the ESX/ESXi release.

The installation software searches for and updates existing RPM packages if found, or installs a new package.

11 Unmount the CD-ROM image:

```
umount /dev/cdrom
```

12 Run the ./usr/bin/vmware-config-tools.pl script to configure tools.

13 Log off the root account:

```
exit
```

What to do next

After you install or upgrade VMware Tools on a virtual machine, verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.

Install VMware Tools on a Solaris Guest

Install the latest version of VMware Tools to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

Before you install or upgrade VMware Tools on a virtual machine, determine the status of VMware Tools. To do this, select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

Prerequisites

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1 From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.

2 Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.

3 Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.

4 Select **Interactive Tools Installation** and click **OK.**

This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.

5 In the virtual machine console, log in as root (`su –`) and, if necessary, mount the VMware Tools virtual CD-ROM image, as follows.

Usually, the Solaris volume manager mounts the CD-ROM under `/cdrom/vmwaretools`. If the CD-ROM is not mounted, restart the volume manager using the following commands.

```
/etc/init.d/volmgt stop
/etc/init.d/volmgt start
```

6 After the CD-ROM is mounted, change to a working directory (for example, `/tmp`) and extract VMware Tools.

```
cd /tmp
gunzip –c /cdrom/vmwaretools/vmware–solaris–tools.tar.gz | tar xf –
```

7 Run the VMware Tools tar installer.

```
cd vmware–tools–distrib
./vmware–install.pl
```

Respond to the configuration questions on the screen. Press Enter to accept the default values.

8 Log off of the root account.

```
exit
```

What to do next

Verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.

Install VMware Tools on a NetWare Guest

Install or upgrade VMware Tools to the latest version to enhance the performance of the virtual machine's guest operating system and improve virtual machine management.

Before you upgrade VMware Tools on a virtual machine, determine the status of VMware Tools. To do this, select the virtual machine and click the **Summary** tab. The **VMware Tools** label indicates whether VMware Tools is installed and current, installed and not current, or not installed.

Prerequisites

- A supported guest operating system must be installed on the virtual machine.
- You must have an ESX/ESXi license or be using evaluation mode to power on the virtual machine.

Procedure

1 From the vSphere Client, right-click the virtual machine, select **Power**, and select **Power On**.

2 Click the **Console** tab to make sure that the guest operating system starts successfully, and log in if necessary.

3 Right-click the virtual machine, select **Guest**, and select **Install/Upgrade VMware Tools**.

4 Select **Interactive Tools Installation** and click **OK.**

This step initiates the installation process by mounting the VMware Tools bundle on the guest operating system.

5 In the virtual machine console, load the CD-ROM driver so the CD-ROM device mounts the ISO image as a volume. To open the Netware Server Console, select **Novell > Utilities > Server Console**.

6 Do one of the following:

- In the NetWare 6.5 Server Console, enter: **`LOAD CDDVD`**.
- In the NetWare 6.0 or NetWare 5.1 Server Console, enter: **`LOAD CD9660.NSS`**.

7 In the Server Console, enter the following command.

```
vmwtools:\setup.ncf
```

When the installation finishes, the message `VMware Tools for NetWare are now running` appears in the Logger Screen (NetWare 6.5 and NetWare 6.0 guests) or the Console Screen (NetWare 5.1 guests).

What to do next

Verify the status of VMware Tools by checking the **VMware Tools** label on the virtual machine **Summary** tab. The **VMware Tools** label should display the word **OK**.

Display the VMware Tools Properties Dialog Box

Use the VMware Tools Properties dialog box to configure VMware Tools inside your virtual machine. Instructions for displaying this dialog box vary, depending on the guest operating system.

Use this dialog box to configure time synchronization between host and guest, notifications of VMware Tools updates (for Windows and Linux guests only), and specifying which scripts to run when the virtual machine's power state changes.

Procedure

- On a Windows guest: Open a console to the virtual machine and double-click the **VMware Tools** icon in the system tray from inside the guest operating system.
- On a Linux or Solaris guest: Open a console to the virtual machine and open a terminal window and enter the command:

  ```
  /usr/bin/vmware-toolbox &
  ```

- On a NetWare guest: Select **Novell > Settings > VMware Tools for NetWare**.

VMware Tools Upgrades

You can upgrade VMware Tools manually, or you can configure virtual machines to check for and install newer versions of VMware Tools

The following are required for automatic upgrades:

- Virtual machines must have a version of VMware Tools shipped with ESX Server 3.0.1 or greater installed.
- Virtual machines must be hosted on an ESX Server 3.0.1 or greater, and the vCenter Server must be version 2.0.1 or greater.
- Virtual machines must be running a Linux or Windows guest OS that is supported by ESX Server 3.0.1 or greater and vCenter Server 2.0.1 or greater.
- Virtual machines must be powered on.

Upgrade VMware Tools Manually

You can manually upgrade VMware Tools.

Procedure

1 Launch the vSphere client and log in to the vCenter Server system.

2 Select the **Inventory > Hosts and Clusters** view.

3 Select the host or cluster that contains the virtual machines you want to upgrade.

4 Select the **Virtual Machines** tab.

5 Select the virtual machines you want to upgrade.

6 Right-click your selections and select **Install/Upgrade Tools**.

7 (Optional) Enter command-line options in the **Advanced** field.

Command-line options for Linux are documented in the Linux installer for Linux Tools. Command-line options for Windows are documented in the MSI for Windows Tools and at the following Wikipedia entry: http://en.wikipedia.org/wiki/Windows_Installer.

8 Click **OK**.

VMware Tools can also be manually upgraded from within the virtual machine's operating system by opening the VMware Tools Properties dialog box (double-click the icon in the system tray) and clicking **Upgrade** in the **Options** tab.

Configure Virtual Machines to Automatically Upgrade VMware Tools

Virtual Machines can be configured so VMware Tools are automatically upgraded.

NOTE Automatic VMware Tools upgrade is not supported for virtual machines with Solaris or Netware guest operating systems.

The following are required for automatic upgrades:

- Virtual machines must have a version of VMware Tools shipped with ESX Server 3.0.1 or greater installed.
- Virtual machines must be hosted on an ESX Server 3.0.1 or greater, and the vCenter Server must be version 2.0.1 or greater.
- Virtual machines must be running a Linux or Windows guest OS that is supported by ESX Server 3.0.1 or greater and vCenter Server 2.0.1 or greater.
- Virtual machines must be powered on.

Procedure

1 Open the Virtual Machine Properties dialog box for the virtual machine you want to upgrade.

2 Select **Options tab > VMware Tools**.

3 Select the **Check and upgrade Tools before each power-on** option under **Automatic VMware Tools Upgrade**.

4 Click **OK**.

The next time the virtual machine is powered on, it checks the ESX/ESXi host for a newer version of VMware Tools. If one is available, it is installed and the guest operating system is restarted (if required).

Custom VMware Tools Installation

You can use a custom VMware Tools installation path to install optional drivers or other software that might improve the performance of particular virtual machines, such as WYSE Multimedia Support.

Procedure

1 Open a console to the virtual machine.

2 Power on the virtual machine.

3 After the guest operating system starts, right-click the virtual machine and select **Install VMware Tools**.

4 From inside the virtual machine, click **OK**to confirm that you want to install VMware Tools and launch the InstallShield wizard.

- If you have autorun enabled in your guest operating system (the default setting for Windows operating systems), a dialog box appears.
- If autorun is not enabled, run the VMware Tools installer. Click **Start > Run** and enter `D:\setup.exe`, where D: is your first virtual CD-ROM drive.

5 Click **Next**.

6 Select **Custom**, and click **Next**.

7 Click the red X next to each optional feature you want to install, and select **This feature will be installed on local hard drive**.

8 Click **Next**.

9 Click **Finish**.

WYSE Multimedia Support

If you are using a WYSE thin client device to conduct remote desktop sessions using VMware VDI, installing WYSE Multimedia Support in the guest operating system improves the performance of streaming video. WYSE Multimedia Support allows streaming video to be decoded on the client rather than on the host, thereby conserving network bandwidth.

WYSE Multimedia Support is supported on the Windows 2003 and Windows XP guest operating systems only. WYSE Multimedia Support is installed as part of a VMware Tools installation or upgrade.

Install WYSE Multimedia Support with VMware Tools

When you install VMware Tools in a Windows 2003 or Windows XP guest operating system for the first time, you can install WYSE Multimedia Support at the same time by choosing a custom installation path.

Procedure

- Follow the instructions for the custom installation path as described in "Custom VMware Tools Installation," on page 132. On the Custom Setup page, select **WYSE Multimedia Redirector** for installation.

Install WYSE Multimedia Support Using Add or Remove Programs

For virtual machines that already have VMware Tools installed, WYSE Multimedia Support can be installed as part of a VMware Tools upgrade using the Windows Add or Remove Programs feature.

Procedure

1 Open a console to a powered-on virtual machine.

2 In the virtual machine, select **Start > Settings > Control Panel > Add or Remove Programs**.

3 In the list of programs, select VMware Tools and click **Change**.

4 Click **Next**.

5 Select **Modify** and click **Next**.

6 Click the red X next to **WYSE Multimedia Redirector** and select **This feature will be installed on local hard drive**.

7 Click **Next**.

8 Click **Modify** to begin the installation.

9 Click **Finish**.

For virtual machines on ESX Server 3.0.1 or later hosts managed by vCenter Server 2.0.1 or later, WYSE Multimedia Support can be installed as part of a VMware Tools upgrade started from the vSphere Client.

Install WYSE Multimedia Support as Part of a VMware Tools Upgrade

For virtual machines on ESX Server 3.0.1 or later hosts managed by vCenter Server 2.0.1 or later, WYSE Multimedia Support can be installed as part of a VMware Tools upgrade started from the vSphere Client.

Procedure

1 Right-click a powered-on virtual machine and select **Upgrade VMware Tools**.

2 In the Advanced text box, type **`setup.exe /s /v"INSTALL_WYSE=1"`**.

3 Click **OK**.

12 Managing Virtual Machines

You can manage virtual machines directly through the ESX/ESXi host or through a vCenter Server system.

If you manage your virtual machines directly through an ESX/ESXi host (a single or standalone system), you can manage only those virtual machines and their resources installed on that host.

If you manage your virtual machines through a vCenter Server system, you can manage multiple virtual machines and their resources distributed over many ESX/ESXi hosts. Multiple vCenter Server systems can be joined together in a vCenter Server Connected Group to allow them to be managed with a single vSphere Client connection.

The vSphere Client is a flexible, configurable interface for managing your virtual machines through an ESX/ESXi host or through vCenter Server.

Figure 12-1 illustrates the components in an ESX/ESXi Virtual Infrastructure.

Figure 12-1. vSphere Components with an ESX/ESXi Host

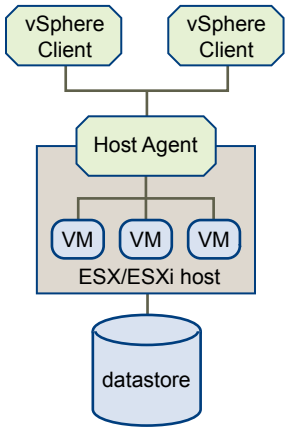
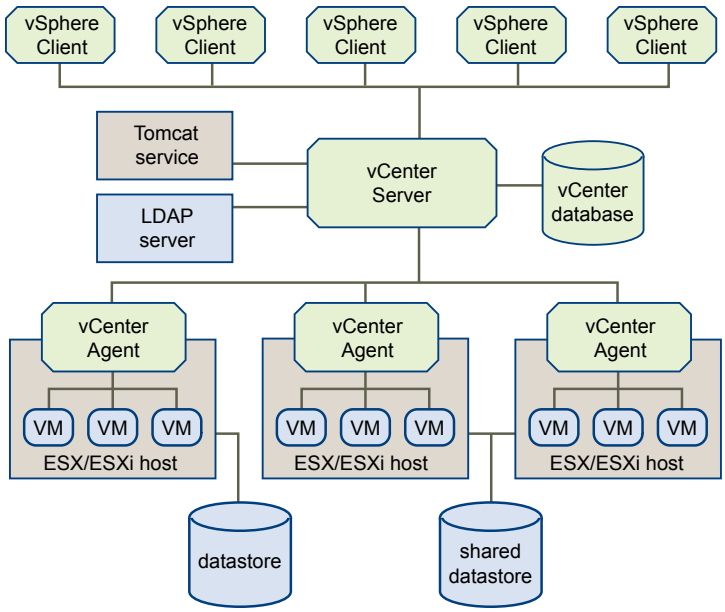


Figure 12-2 illustrates the components in a vCenter Server Virtual Infrastructure.

Figure 12-2. vSphere Components with a vCenter Server System



This chapter includes the following topics:

- "Changing Virtual Machine Power States," on page 136
- "Adding and Removing Virtual Machines," on page 139
- "Configure Virtual Machine Startup and Shutdown Behavior," on page 140

Changing Virtual Machine Power States

The power state of a virtual machine indicates whether the virtual machine is active and functional.

There are several access points for making changes to power states:

- Selecting the virtual machine and the power option from the **Inventory > Virtual Machine** menu.
- Selecting **Power on** from the **Commands** area.
- Selecting the power option from the right-click menu.
- Scheduling a power state change using the **Scheduled Tasks** button in the navigation bar.

Power on	Powers on the virtual machine and boots the guest operating system if the guest operating system is installed. When applied to a suspended virtual machine, allows virtual machine activity to continue and releases the suspended state.
Power off	Powers off the virtual machine. The virtual machine does not attempt to shut down the guest operating system gracefully.
Suspend	Pauses the virtual machine activity. All virtual machine operations are frozen until you issue a resume command.
Reset	Shuts down the guest operating system and restarts it.

The following power options perform extra functions in addition to the basic virtual machine power operations. VMware Tools must be installed in the virtual machine to perform these functions:

Shut down guest	Shuts down the guest operating system gracefully.
Restart guest	Shuts down and restarts the guest operating system without powering off the virtual machine.

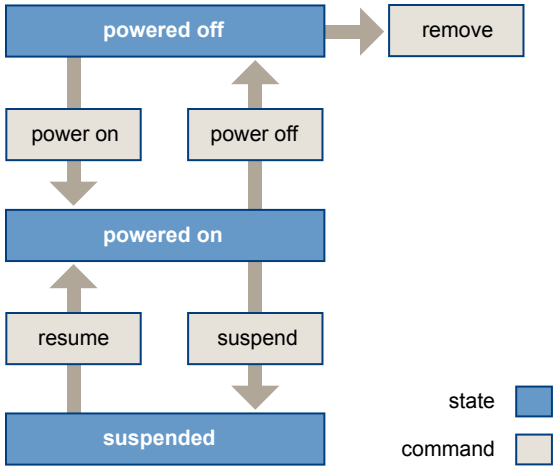
Transitional Power States

Actions taken on a virtual machine require that the virtual machine be in specific power states.

When a power operation is performed on a virtual machine, the virtual machine power state changes and all other commands are locked out until the first command is completed.

The figure below illustrates states, transitions, and state-changing commands for virtual machines.

Figure 12-3. Virtual Machine Power State Changes



Automatically Start or Shutdown Virtual Machines with Host Start or Shutdown

You can configure which virtual machines automatically start and shut down when the host is started or shut down.

Procedure

1 Select the host in the inventory.

2 In the **Configuration** tab, select **Virtual Machine Startup/Shutdown**.

Configure vSphere Toolbar Power Controls

You can specify the behavior of vSphere power controls.

Procedure

1 Log in to vSphere client.

2 On the Home page, select **VMs and Templates**.

3 Right-click on a virtual machine and select **Edit Settings**.

4 Select the **Options** tab.

5 Select **VMware Tools**.

6 In the right panel, enter the settings you want for the Power Controls, Run VMware Tools Scripts, and Advanced options.

7 Click **OK** to save your settings and close the dialog box.

Power On or Power Off a Virtual Machine Manually

You can power on or off a virtual machine manually.

Powering on a virtual machine boots the guest operating system if the guest operating system is installed. Powering off a virtual machine is analogous to pressing the off button on a computer without performing a shut down from the operating system. The virtual machine does not attempt to shut down the guest operating system gracefully.

Procedure

1 Log in to the vSphere Client.

2 Display the virtual machine in the inventory.

3 Select the virtual machine and do one of the following:

- Click the power state button in the toolbar.
- Right-click the virtual machine and select the power state option.

The shut down power state button in the toolbar performs a shut-down and not a power off by default. You can configure this option in the virtual machine settings.

Suspend a Virtual Machine

The suspend and resume feature is most useful when you want to save the current state of your virtual machine and pick up work later with the virtual machine in the same state.

The speed of the suspend and resume operations depends on how much data changed while the virtual machine was running. In general, the first suspend operation takes a bit longer than subsequent suspend operations take.

When you suspend a virtual machine, a file with a `.vmss` extension is created. This file contains the entire state of the virtual machine. When you resume the virtual machine, its state is restored from the `.vmss` file.

Procedure

1 When you suspend a virtual machine, a file with a `.vmss` extension is created. This file contains the entire state of the virtual machine. When you resume the virtual machine, its state is restored from the `.vmss` file. If your virtual machine is running in full-screen mode, return to window mode by pressing Ctrl+Alt.

2 On the vSphere Client toolbar, click **Suspend**.

When the vSphere Client completes the suspend operation, it is safe to close the client.

3 Select **File > Exit**.

Resume a Suspended Virtual Machine

After you resume a virtual machine and do additional work in the virtual machine, you cannot return to the state the virtual machine was in at the time you suspended. To preserve the state of the virtual machine so you can return to the same state repeatedly, take a snapshot.

Procedure

1 Start the vSphere Client and display the virtual machine in the inventory.

2 Do one of the following:

- Select the virtual machine and click **Power On** in toolbar.
- Right-click the virtual machine and select **Power On** in the context menu.
- Select the virtual machine and in the **Summary** tab **Commands** window, select **Power On**.

Applications you were running at the time you suspended the virtual machine are running and the content is the same as it was when you suspended the virtual machine.

Scheduling a Power State Change for a Virtual Machine

You can create a scheduled task to power on, power off, or suspend a virtual machine at a designated time.

When you create the scheduled task, vCenter Server verifies that you have the correct permissions to perform the actions on the relevant datacenters, hosts, and virtual machines. Once the task is created, the task is performed even if you no longer have permission to perform the task.

Adding and Removing Virtual Machines

You add virtual machines to the vCenter Server inventory through their managed hosts. You can remove virtual machines from vCenter Server, from their managed host's storage, or both.

Adding Existing Virtual Machines to vCenter Server

When you add a host to vCenter Server, it discovers all the virtual machines on that managed host and adds them to the vCenter Server inventory.

If a managed host is disconnected, the already discovered virtual machines continue to be listed in the inventory.

If a managed host is disconnected and reconnected, any changes to the virtual machines on that managed host are identified, and the vSphere Client updates the list of virtual machines. For example, if node3 is removed and node4 is added, the new list of virtual machines adds node4 and shows node3 as orphaned.

Remove Virtual Machines from vCenter Server

Removing a virtual machines from the inventory unregisters it from the host and vCenter Server. It does not delete it from the datastore. Virtual machine files remain at the same storage location and the virtual machine can be re-registered using the datastore browser.

Prerequisites

Power off the virtual machine.

Procedure

1 Display the virtual machine in the inventory.

2 Right-click the virtual machine and select **Remove from Inventory**.

3 To confirm that you want to remove the virtual machine from the inventory, click **OK**.

vCenter Server removes references to the virtual machine and no longer tracks its condition.

Remove Virtual Machines from the Datastore

Use the **Delete from Disk** option to remove a virtual machine from vCenter Server and delete all virtual machine files, including the configuration file and virtual disk files, from the datastore.

Prerequisites

Power off the virtual machine.

Procedure

1 Display the virtual machine in the inventory.

2 Right-click the virtual machine and select **Delete from Disk**.

3 Click **OK** in the confirmation dialog box.

vCenter Server deletes the virtual machine from its datastore. Disks that are shared with other virtual machines are not deleted.

Return a Virtual Machine or Template to vCenter Server

If you removed a virtual machine or template from vCenter Server, but did not remove it from the managed host's datastore, you can return it to vCenter Server using the Datastore Browser.

Procedure

1 Display the datastore in the inventory.

2 Right-click the datastore and select **Browse Datastore**.

3 Navigate to the virtual machine or template to add to the inventory.

4 Right-click the virtual machine or template and select **Add to Inventory**.

5 Complete the Add to Inventory wizard to add the virtual machine or template.

Configure Virtual Machine Startup and Shutdown Behavior

You can configure a virtual machine to start up and shut down automatically, or you can disable this function. You can also set the default timing and the startup order for specified virtual machines when the system host starts.

Procedure

1 In the inventory, display the host where the virtual machine is located.

2 Select the host and click the **Configuration** tab.

3 Click **Virtual Machine Startup/Shutdown**, and click **Properties**.

4 Select **Allow virtual machines to start and stop automatically with the system**.

5 Click **Continue immediately if the VMware Tools starts** to have the operating system boot immediately after VMware Tools starts.

6 To have the operating system start after a brief delay, enter a **Default Startup Delay** time.

This delay allows time for VMware Tools or the booting system to run scripts.

7 Select a shutdown action.

8 Enter a **Default Shutdown Delay** value to delay shutdown for each virtual machine by a certain amount of time.

This shutdown delay applies only if the virtual machine has not already shut down before the delay period elapses. If the virtual machine shuts down before that delay time is reached, the next virtual machine starts shutting down.

9 Use **Move Up** and **Move Down** to specify the order in which the virtual machines start when the system starts.

10 To configure user-specified autostartup and autoshutdown behavior for any virtual machine, select the virtual machine and click **Edit**.

Virtual Machine Configuration 13

You can configure virtual machines at any time—during the virtual machine creation process or after you create the virtual machine and install the guest operating system.

You can configure virtual machines using two tools in the vSphere Client: the Virtual Machine Properties editor and the Add Hardware wizard. These dialog boxes also allow you to control advanced virtual machine configuration options. You can also upgrade the virtual hardware of a virtual machine or convert virtual disks from thin to thick using these dialog boxes.

You must have sufficient permission to perform virtual machine configuration tasks.

This chapter includes the following topics:

- "Virtual Machine Hardware Versions," on page 143
- "Virtual Machine Properties Editor," on page 144
- "Adding New Hardware," on page 159
- "Converting Virtual Disks from Thin to Thick," on page 166

Virtual Machine Hardware Versions

All virtual machines have a hardware version. The hardware version of a virtual machine indicates the lower-level virtual hardware features supported by the virtual machine, such as BIOS, number of virtual slots, maximum number of CPUs, maximum memory configuration, and other characteristics typical to hardware.

The default virtual machine hardware version of a newly created virtual machine is the most recent version available on the host where the virtual machine is created. If you need to create a virtual machine with a hardware version older than the highest supported in order to increase compatibility, you can use the custom virtual machine creation path. The hardware version of a virtual machine can be lower than the highest version supported by the ESX/ESXi host it is running on if:

- You migrate a virtual machine created on an ESX/ESXi 3.x or earlier host to an ESX/ESXi 4.x host.
- You create a new virtual machine on an ESX 4.x host using an existing virtual disk that was created on an ESX/ESXi 3.x or earlier host.
- You add a virtual disk created on an ESX/ESXi 3.x or earlier host to a virtual machine created on an ESX/ESXi 4.x host.

Virtual machines with hardware versions lower than 4 can run on ESX/ESXi 4.x hosts but have reduced performance and capabilities. In particular, you cannot add or remove virtual devices on virtual machines with hardware versions lower than 4 when they reside on an ESX/ESXi 4.x host. To make full use of these virtual machines, upgrade the virtual hardware as described in the *Upgrade Guide*.

Table 13-1 lists virtual machine hardware versions, the ESX/ESXi versions on which they can be created, edited, and run, the vCenter Server versions on which they are fully supported, and a brief description of the hardware version's capabilities.

Table 13-1. Virtual Machine Hardware Versions

	Version 7	Version 4	Version 3	Compatible with vCenter Server version
ESX/ESXi 4.x	create, edit, run	create, edit, run	run	vCenter Server 4.x
ESX Server 3.x	–	create, edit, run	run	VirtualCenter Server 2.x and higher
ESX Server 2.x	–	–	create, edit, run	VirtualCenter Server 1.x and higher

NOTE Virtual machine hardware version 4 may be listed as VM3 in documentation for earlier versions of ESX and ESXi. Virtual machine hardware version 3 may be listed as VM2 in documentation for earlier versions of ESX.

Determine the Hardware Version of a Virtual Machine

You can determine the hardware version of a virtual machine by looking in the **Summary** tab for the virtual machine or the Virtual Machine Properties dialog box.

Procedure

1 Select the virtual machine in the inventory.

2 Select one of the two methods for viewing the version information.

Option	Description
Select the Summary tab.	The virtual machine hardware version appears at the top right corner of the **Summary** tab.
Right-click and select Edit Settings.	The virtual machine hardware version appears at the top right corner of the Virtual Machine Properties dialog box.

Virtual Machine Properties Editor

The Virtual Machine Properties editor allows you to change nearly every characteristic that you selected when you created the virtual machine.

Edit an Existing Virtual Machine Configuration

You can edit almost all of the configuration for a virtual machine with the Virtual Machine Properties dialog box.

Some properties of a virtual machine can be changed only while it is powered off, but you can open the properties editor regardless of the power state. Some of the controls are read-only if the virtual machine is not powered off.

NOTE If a virtual machine is on a host managed by vCenter Server, be sure to connect to vCenter Server when adding or modifying virtual hardware for the virtual machine. If you connect the vSphere Client directly to the host, add hardware operations might fail with the error message `Cannot complete operation due to concurrent modification by another operation`.

Procedure

1 From the vSphere Client, click **Inventory** in the navigation bar.

2 Expand the inventory as needed, and select the virtual machine you want to edit.

3 (Optional) Power off the virtual machine.

4 Click the **Edit Settings** link in the Commands panel to display the Virtual Machine Properties dialog box.

The Virtual Machine Properties dialog box appears. There are three tabs: **Hardware**, **Options**, and **Resources**.

5 Select a tab and edit the virtual machine configuration.

What to do next

Refer to the following sections for more information about the tabs in the Virtual Machine Properties dialog box and editing existing virtual machines.

- "Virtual Machine Hardware Configuration," on page 145
- "Virtual Machine Options," on page 150
- "Virtual Machine Resource Settings," on page 155

Virtual Machine Hardware Configuration

You can add, edit, or remove hardware from your virtual machine.

The status of the device, such as edited or adding, appears in parentheses next to the hardware listing. The selected guest operating system determines the devices that are available to be added to a given virtual machine. The devices that can be added are:

- Serial port
- Parallel port
- Floppy drive
- DVD/CD-ROM drive
- USB Controller
- Ethernet adapter
- Hard disk
- SCSI device

Change the Video Card Configuration

Virtual video cards cannot be added or removed. You can configure a virtual video card to select the maximum number of displays and set the amount of video memory allocated.

Procedure

1 In the vSphere Client inventory, right-click on a virtual machine and select **Edit Settings**.

2 Select the **Hardware** tab.

3 Select **Video card**.

4 Select the number of displays.

5 Select a memory option.

The default setting for total video RAM is 4MB, which is sufficient for a maximum screen resolution of 1176x885. For higher screen resolutions, set this option to 16MB.

Change the DVD/CD-ROM Drive Configuration

Use the **Hardware** tab in the Virtual Machine Properties dialog box to configure a DVD/CD-ROM drive for a virtual machine.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the DVD/CD-ROM drive in the Hardware list.

3 Select or deselect the **Connected** check box to connect or disconnect the device.

4 If you do not want the CD-ROM drive connected when the virtual machine starts, deselect **Connect at power on**.

5 Select whether to use a client device, host device, or ISO file.

Option	Description
Client Device	Select this option to connect the DVD/CD-ROM device to a physical DVD or CD-ROM device on the system running the vSphere Client. To connect the device, you must click the **Connect CD/DVD** button in the toolbar when you power on the virtual machine.
Host Device	a Select this option to connect the DVD/CD-ROM device to a physical DVD or CD-ROM device on the host. b Select the specific device from the drop-down list.
Datastore ISO File	a Select this option to connect the DVD/CD-ROM device to an ISO file stored on a datastore accessible to the host. b Click **Browse** and select the ISO file.

6 For client devices, select the mode used for the connection.

- Use Pass-through (raw) mode only for remote client device access.
- Use ATAPI emulation to access a host CD-ROM device.

  The host CD-ROM device is accessed through emulation mode. Pass-through mode is not functional for local host CD-ROM access. You can write or burn a remote CD only through pass-through mode access, but in emulation mode you can only read a CD-ROM from a host CD-ROM device.

7 Alternatively, select **Use ISO Image** to connect the virtual machine's drive to an ISO image file.

8 If you selected **Use ISO Image**, click **Browse** to navigate to the file.

9 Under Virtual device node, use the drop-down menu to select the device node the drive uses in the virtual machine.

10 Click **OK** to save your changes and close the dialog box.

Change the Floppy Drive Configuration

Use the **Hardware** tab in the Virtual Machine Properties dialog box to configure a floppy drive for a virtual machine.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the floppy drive in the Hardware list.

3 Under Device Status, select **Connect at power on** to connect this virtual machine to the floppy drive when the virtual machine is powered on.

4 Select the device type to use for this virtual device.

Option	Description
Client Device	Select this option to connect the floppy device to a physical floppy device on the system running the vSphere Client. To connect the device, you must click the **Connect Floppy** button in the toolbar when you power on the virtual machine.
Host Device	a Select this option to connect the floppy device to a physical floppy device on the host. b Select the specific device from the drop-down list.
Use existing floppy image in datastore	a Select this option to connect the virtual device to an existing floppy image on a datastore accessible to the host. b Click **Browse** and select the floppy image.
Create new floppy image in datastore	a Select this option to create a new floppy image on a datastore accessible to the host. b Click **Browse** and browse to the location for the floppy image. c Enter a name for the floppy image and click **OK**.

5 Click **OK** to save your changes and close the dialog box.

Change the SCSI Device Configuration

You can change the physical device and the virtual device node of the SCSI device connection.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Select the SCSI device in the Hardware list.

3 Under **Connection**, select the physical device you want to use.

Under Virtual device node, select the virtual device node where you want this device to appear in the virtual machine.

4 Click **OK** to save your changes and close the dialog box.

Change the Virtual Disk Configuration

You can change the virtual device node, the size of the disk, and the persistence mode for virtual disk configuration for a virtual machine.

NOTE The Manage Paths feature for RDM disks is not available for virtual machines on legacy hosts running versions of ESX Server prior to release 3.0.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the appropriate Hard Disk in the Hardware list.

3 Use the drop-down menu to change the virtual device node.

4 To change the size of the disk, enter a new value in the **Provisioned Size** text box.

5 For independent mode, which is unaffected by snapshots, select the check box. Then select Persistent or Nonpersistent mode to determine the persistence of changes.

6 Click **OK** to save your changes and close the dialog box.

Change the Memory Configuration

You can change the memory configuration of a virtual machine's hardware when the virtual machine is powered on or powered off.

When you add memory to a virtual machine while it is powered on, the amount you add cannot exceed 16 times the amount of memory the virtual machine had when it was powered on.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click **Memory** in the Hardware list.

3 Adjust the amount of memory allocated to the virtual machine.

4 Click **OK** to save your changes and close the dialog box.

Change the Virtual Ethernet Adapter (NIC) Configuration

You can change the power-on connection setting, the MAC address, and the network connection for the virtual Ethernet adapter configuration for a virtual machine.

Procedure

1 Click the **Hardware** tab.

2 Click the appropriate NIC in the Hardware list.

3 To connect the virtual NIC when the virtual machine is powered on, select **Connect at power on**.

4 Select an option for MAC address configuration.

- Select **Automatic** to assign a MAC address automatically.
- Select **Manual** and enter a MAC address to use a manual MAC address assignment.

5 Under Network connection, use the drop-down menu to select the network label you want the virtual machine to use.

6 Click **OK** to save your changes and close the dialog box.

Change the Parallel Port Configuration

You can use a physical parallel port or an output file to configure a parallel port for a virtual machine.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the appropriate Parallel port in the Hardware list.

3 Deselect the **Connect at power on** check box if you do not want the parallel port device to be connected when the virtual machine powers on.

The default setting is **Connect at power on**.

4 Under Connection, select a button to indicate a physical parallel port or to connect the virtual parallel port to a file.

- If you select **Use physical parallel port**, select the port from the drop-down menu.
- If you select **Use output file**, browse to the file location.

5 Click **OK** to save your changes and close the dialog box.

Change the SCSI Controller or SCSI Bus Sharing Configuration

You can set the SCSI controller type and the type of SCSI bus sharing for a virtual machine. SCSI bus sharing can set to none, virtual, or physical sharing types.

You can change the SCSI controller configuration for a virtual machine on an ESX/ESXi host only.

CAUTION Changing the SCSI controller type might result in a virtual machine boot failure.

You can also specify whether the SCSI bus is shared. Depending on the type of sharing, virtual machines can access the same virtual disk simultaneously on the same server or any server.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the appropriate SCSI Controller in the Hardware list.

3 Under SCSI Controller Type, click **Change Type**.

4 Select the SCSI controller type.

5 Click **OK**.

6 Select the type of sharing in the **SCSI Bus Sharing** list:

Option	Description
None	Virtual disks cannot be shared by other virtual machines.
Virtual	Virtual disks can be shared by virtual machines on same server.
Physical	Virtual disks can be shared by virtual machines on any server.

7 Click **OK** to save your changes and close the dialog box.

Change the Serial Port Configuration

You can use a physical serial port, an output file, or a named pipe to configure a serial port for a virtual machine.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click the appropriate Serial port in the Hardware list.

3 If you selected **Use physical serial port on the host**, use the drop-down menu to select the port on the host computer that you want to use for this serial connection.

4 If you selected **Use output file**, browse to the location of the file on the host that you want to use to store the output of the virtual serial port.

5 If you selected **Use named pipe**, use the default pipe name or enter another pipe name of your choice in the **Pipe Name** list.

For a serial pipe for a virtual machine on an ESX host for Linux, enter **`/tmp/<socket>`** or another UNIX socket name of your choice.

Then decide whether you are connecting two virtual machines or connecting a virtual machine to an application on the host.

6 If you are connecting two virtual machines, you must configure a serial port as a named pipe in two virtual machines: a server virtual machine and a client virtual machine.

   a For the server virtual machine, select **Server** in the **Near end** list.

   b For the client virtual machine, select **Client** in the **Near end** list.

   c Select **A virtual machine** in the **Far end** list.

7 If you are connecting to an application on the host, do the following:

   a Select **Server** or **Client** in the **Near end** list. In general, select **Server** if you plan to start this end of the connection first.

   b Select **An application** in the **Far end** list.

   By default, the serial port is connected when you power on the virtual machine. You might deselect the **Connect at power on** check box (optional).

8 Under **I/O Mode**, decide whether to configure this serial port to use interrupt mode or polled mode.

   Polled mode is of interest primarily to developers who are using debugging tools that communicate over a serial connection.

   Polled mode causes the virtual machine to consume a disproportionate share of processor (or CPU) time. This makes the host and other guests run sluggishly. To maintain best performance for applications on the host, select the **Yield CPU on poll** check box. This forces the affected virtual machine to use interrupt mode, which yields processor (or CPU) time if the only task it is trying to do is poll the virtual serial port.

9 Click **OK** to save your changes and close the dialog box.

Change the Virtual Processor or CPU Configuration

You can configure more than one virtual processor or CPU for a virtual machine using VMware Virtual SMP for ESX.

If the virtual machine is on an ESX/ESXi host, you can configure a virtual machine to have up to eight virtual processors or CPUs. Virtual machines cannot have more virtual CPUs than the actual number of logical CPUs on the host—that is, the number of physical processor cores if hyperthreading is disabled or two times the number of physical processor cores if hyperthreading is enabled. For more information about using SMP, consult the VMware Knowledge Base.

NOTE Not all guest operating systems support SMP, and some that do require reinstallation if the number of CPUs changes.

Procedure

1 In the Virtual Machine Properties Editor, click the **Hardware** tab.

2 Click **Virtual Processor** or **CPU** in the Hardware list.

3 Select the number of virtual processors for the virtual machine.

4 Click **OK** to save your changes and close the dialog box.

Virtual Machine Options

The virtual machine options define a range of virtual machine properties such as name, vApp functionality, its behavior with the guest operating system and VMware Tools, and other Advanced options.

You can change the following settings in the Options tab of the Virtual Machine Properties Editor:

General Options	Virtual machine display name and type of guest operating system. (Read-only) location of virtual machine and its configuration file.
Appliance Options	Virtual machine options for functionality, product information, properties, and OVF settings specific to virtual appliances.
VMware Tools	Power Controls behavior, VMware Tools scripts and automatic updates.
Power Management	Virtual machine Suspend behavior.
Advanced > General	Acceleration, logging, debugging and statistics.
Advanced > CPUID Mask	NX flag and advanced identification mask options.
Advanced > Memory/CPU Hotplug	Hot add enablement for individual virtual machines.
Advanced > Boot Options	Virtual machine boot options.
Advanced > Paravirtualization	VMI paravirtualization enablement
Advanced > Fibre Channel NPIV	Virtual node and port World Wide Names (WWNs).
Advanced > CPU/MMU Virtualization	Settings for enabling Hardware Page Table Virtualization.
Advanced > Swapfile Location	Swapfile location.

Change the General Settings of a Virtual Machine

Change the virtual machine name and guest operating system settings in the **General Options** in the Virtual Machine Properties dialog box.

Procedure

1 Click the **Options** tab.

2 Select **General Options** in the **Settings** list.

The virtual machine name appears in the Virtual machine name field.

Changing the name does not change the name of any virtual machine files or the associated directory.

3 Select an operating system and version.

4 Click **OK** to save your changes and close the dialog box.

Change the VMware Tools Options for a Virtual Machine

You can change the power controls, the time VMware Tools scripts run, the upgrade check option, and the time synchronization option with the VMware Tools settings for a virtual machine.

VMware Tools options cannot be changed while the virtual machine is powered on.

Procedure

1 Click the **Options** tab.

2 Select **VMware Tools**in the **Settings** list.

The stop button on the toolbar can be configured to power off the virtual machine, shut down the guest operating system, or use the system default. The pause button on the toolbar can be configured to suspend the virtual machine or use the system default. The reset button on the toolbar can be configured to reset the virtual machine, restart the guest operating system, or use the system default.

3 Select the actions you want from the drop-down menus under **Power Controls**.

4 (Optional) Configure VMware Tools scripts to run when you change the virtual machine's power state by selecting options under **Run VMware Tools** scripts.

NOTE For ESX host virtual machines, there are no scripts for resuming and suspending virtual machines.

5 (Optional) Configure VMware Tools to check for and install updates before each power on by selecting the **Check and upgrade Tools before each power on** option under **Automatic VMware Tools Upgrade**.

6 (Optional) Configure the guest operating system to synchronize time with the host by selecting the **Synchronize guest time with host** option.

7 Click **OK** to save your changes and close the dialog box.

Change Power Management Settings for a Virtual Machine

Power Management allows you to determine how the virtual machine responds when the guest operating system is placed on standby.

Procedure

1 Click the **Options** tab.

2 Select **Power Management** in the **Settings** list.

3 Under **Guest Power Management**, select either **Suspend the virtual machine** or **Put the guest operating system in standby mode and leave the virtual machine powered on**.

4 (Optional) If you chose to leave the virtual machine on, select **Wake on LAN for virtual machine traffic on** your virtual machine network by selecting the check box.

Not all guest operating systems support Wake on LAN. Only the following types of NICs support Wake on LAN:

- Flexible (VMware Tools required).
- vmxnet
- Enhanced vmxnet
- vmxnet 3

Options are disabled if they are not supported.

5 Click **OK** to save your changes and close the dialog box.

Change Advanced Virtual Machine Settings

The virtual machine options define a range of virtual machine properties such as name, vApp functionality, its behavior with the guest operating system and VMware Tools, and other Advanced options.

Procedure

1 Click the **Options** tab.

2 Select **Advanced > General** in the **Settings** list.

   a To disable acceleration, select the **Disable acceleration** check box.

   You can enable and disable acceleration while the virtual machine is running.

   In rare instances, you might find that when you install or run software inside a virtual machine, the virtual machine appears to stop responding. Generally, the problem occurs early in the program's execution. In many cases, you can get past the problem by temporarily disabling acceleration in the virtual machine.

   This setting slows down virtual machine performance, so use it only for getting past the problem with running the program. After the program stops encountering problems, deselect **Disable acceleration**. You might then be able to run the program with acceleration.

   b To enable logging mode, select the **Enable logging** check box.

   c To enable debugging mode, select an option from the **Debugging and Statistics** section. Debugging information and statistics can be helpful to VMware technical support in resolving issues.

   d To set advanced configuration parameters, click **Configuration Parameters**. Generally, you should only change these settings if you intend to use experimental features or when instructed to do so by a VMware technical support representative.

3 Select **Advanced > CPUID Mask**.

   a Specify whether you want to hide the host's CPU NX flag from the guest operating system.

   Hiding the NX flag prevents the guest operating system from making use of this CPU feature, but enables the virtual machine to be moved to hosts that do not include the NX feature. When the NX flag is visible, the guest operating system can make use of the feature, but the virtual machine can be moved only to hosts with the NX capability.

   b Click **Advanced** to access the CPU Identification Mask dialog box. An explanation of the symbols in this dialog box is available by clicking **Legend**.

   NOTE The virtual machine must be powered off before you can change this setting.

4 Select **Advanced > Memory/CPU Hotplug**. VMware Tools must be installed for hotplug functionality to work properly.

   a Select **Enable memory hot add for this virtual machine**to enable memory hot add, or select **Disable memory hot add for this virtual machine** to disable this feature.

   b Select **Enable CPU hot add only for this virtual machine**to enable CPU hot add, select **Enable CPU hot add and remove for this virtual machine**to enable CPU hot add and remove, or select **Disable CPU hot plug for this virtual machine** to disable this feature.

5 Select **Advanced > Boot Options**.

   a Specify the duration in milliseconds you want to delay entering the boot sequence when the virtual machine is powered on or restarted.

   b Select the option under Force BIOS Setup to have the virtual machine enter BIOS setup when it boots.

   These options are useful when you need to enter the virtual machine's BIOS setup because sometimes the console attaches to the virtual machine after the boot sequence passes the point where you can enter BIOS.

6 Select **Advanced > Paravirtualization**. Select **Support VMI Paravirtualization** to enable VMI Paravirtualization to enable it, or deselect it to disable this feature.

VMI is a paravirtualization standard that enables improved performance for virtual machines capable of utilizing it. Currently, this feature is available only for those versions of the Linux guest operating system which support VMI paravirtualization.

NOTE Enabling paravirtualization utilizes one of the virtual machine's six virtual PCI slots. Also, enabling paravirtualization can limit how and where the virtual machine can be migrated. Consider the following before enabling this feature:

- These hosts support VMI paravirtualization: ESX/ESXi 3.5 and greater, and Workstation 6.0 and greater. Hardware version 4 virtual machines with paravirtualization enabled that are created on ESX hosts can be migrated to Workstation hosts without loss of functionality.
- A virtual machine with paravirtualization enabled and that is powered off can be moved manually to a host that does not support paravirtualization. However, this can result in reduced performance.
- A virtual machine with paravirtualization enabled and that is powered on or in a suspended power state can not be migrated to a host that does not support paravirtualization.
- Automated vCenter Server DRS migrations of virtual machines with paravirtualization enabled to hosts that do not support paravirtualization are not allowed.

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7 Select **Advanced > Fibre Channel NPIV Settings**.

N-port ID virtualization (NPIV) provides the ability to share a single physical Fibre Channel HBA port among multiple virtual ports, each with unique identifiers. This allows control over virtual machine access to LUNs on a per-virtual machine basis.

Each virtual port is identified by a pair of world wide names (WWNs): a world wide port name (WWPN) and a world wide node name (WWNN). These WWNs are assigned by vCenter Server.

NPIV support is subject to the following limitations:

- NPIV must be enabled on the SAN switch. Contact the switch vendor for information about enabling NPIV on their devices.
- NPIV is supported only for virtual machines with RDM disks. Virtual machines with regular virtual disks continue to use the WWNs of the host's physical HBAs.
- The physical HBAs on the ESX host must have access to a LUN using its WWNs in order for any virtual machines on that host to have access to that LUN using their NPIV WWNs. Ensure that access is provided to both the host and the virtual machines.
- The physical HBAs on the ESX host must support NPIV. If the physical HBAs do not support NPIV, the virtual machines running on that host will fall back to using the WWNs of the host's physical HBAs for LUN access.
- Each virtual machine can have up to 4 virtual ports. NPIV-enabled virtual machines are assigned exactly 4 NPIV-related WWNs, which are used to communicate with physical HBAs through virtual ports. Therefore, virtual machines can utilize up to 4 physical HBAs for NPIV purposes.

To view or edit a virtual machine's WWNs:

a To edit the virtual machine's WWNs, power off the virtual machine.

b Ensure that the virtual machine has a datastore containing a LUN that has been made available to the host.

c Select the **Options** tab.

d Select **Fibre Channel NPIV**.

e Currently assigned WWNs are displayed in the WWN Assignments box.

f Do one of the following:

- To leave WWNs unchanged, select **Leave unchanged**.
- To have vCenter Server or the ESX host generate new WWNs, select **Generate New WWNs**.
- To remove the current WWN assignments, select **Remove WWN assignment**.

g Click **OK** to save your changes and close the dialog box.

NOTE A virtual machine with WWNs that are already in use on the storage network is prevented from powering on. To solve this issue, generate new WWNs or remove them.

Provide the WWN assignments to your SAN administrator. The administrator needs those assignments to configure virtual machine access to the LUN. For more information on how to configure NPIV for a virtual machine, see the *Fibre Channel SAN Configuration Guide*.

8 Select **Advanced > Virtualized MMU** and specify whether to disable the feature, always use the feature where available, or have the host system determine whether the feature should be used.

9 Select **Advanced > Swapfile Location**.

10 Select one of the following options:

- **Default** — Store the virtual machine swapfile at the default location defined by the host or cluster swapfile settings. See "Host Configuration," on page 47 for more information on host swapfile settings. See the *Resource Management Guide* for more information on cluster settings.
- **Always store with the virtual machine**— Store the virtual machine swapfile in the same folder as the virtual machine configuration file.
- **Store in the host's swapfile datastore**— Store the virtual machine swapfile in the swapfile datastore defined by the host or cluster swapfile settings.

Virtual Machine Resource Settings

In the Virtual Machine Properties dialog box, you can adjust the host resource allocation for the selected virtual machine. You can change CPU, memory, disk, and advanced CPU resources from this tab.

For more information on resources, see the *Resource Management Guide*.

CPU Resources

The CPU Resources panel of the Virtual Machine Properties dialog box lets you allocate processor resources for a virtual machine, specifying reservations, limits, and shares.

You can edit some of the same information on the Resource Pools tab of the main vSphere Client window, which you might do to edit resource settings at the same time you edited other virtual machine settings.

Change CPU Settings of a Virtual Machine

Use the **Resources** tab in the Virtual Machine Properties dialog box to change the CPU settings of a virtual machine.

Procedure

1 Click the **Resources** tab.

2 Select **CPU** in the **Settings** list.

3 Select a shares value, which represents a relative metric for allocating CPU capacity.

Option	Description
Shares	The values **Low**, **Normal**, **High**, and **Custom** are compared to the sum of all shares of all virtual machines on the server and, on ESX/ESXi hosts, the service console. Share allocation symbolic values can be used to configure their conversion into numeric values.
Reservation	Guaranteed CPU allocation for this virtual machine.
Limit	Upper limit for this virtual machine's CPU allocation. Select **Unlimited** to specify no upper limit.

For more information on share values, see the *Resource Management Guide*.

4 Click **OK** to save your changes.

The Virtual Machine Properties dialog box closes.

Advanced CPU Settings

The Advanced CPU Resources panel of the Virtual Machine Properties dialog box lets you set low-level options that involve scheduling the virtual machine processing to physical processor cores and hyperthreads.

This panel does not appear for virtual machines in a DRS cluster or when the host has only one processor core and no hyperthreading.

NOTE Hyperthreading technology allows a single physical processor to behave like two logical processors. The processor can run two independent applications at the same time. While hyperthreading does not double the performance of a system, it can increase performance by better utilizing idle resources. For detailed information about hyperthreading and its use in vSphere, see the *Resource Management Guide* (select **Help > Manuals**).

ESX generally manages processor scheduling well, even when hyperthreading is enabled. The settings on this page are useful only for fine-grained tweaking of critical virtual machines.

The Hyperthreading Sharing option provides detailed control over whether a virtual machine should be scheduled to share a physical processor core (assuming hyperthreading is enabled on the host at all).

The Scheduling Affinity option allows fine-grained control over how virtual machine CPUs are distributed across the host's physical cores (and hyperthreads if hyperthreading is enabled).

Change Advanced CPU Settings of a Virtual Machine

Set the hyperthreaded core sharing mode for a virtual machine's advanced CPU settings in the **Resource** tab of the Virtual Machine Properties dialog box.

Procedure

1 Click the **Resources** tab.

2 Select **Advanced CPU**in the **Settings** list.

3 Select Hyperthreading Sharing Mode from the drop-down menu.

Option	Description
Any	(default) The virtual CPUs of this virtual machine can freely share cores with other virtual CPUs of this or other virtual machines.
None	The virtual CPUs of this virtual machine have exclusive use of a processor core whenever they are scheduled to it. The other hyperthread of the core is halted while this virtual machine is using the core.
Internal	On a virtual machine with exactly two virtual processors, the two virtual processors are allowed to share one physical core (at the discretion of the host scheduler), but this virtual machine never shares a core with any other virtual machine. If this virtual machine has any other number of processors other than two, this setting is the same as the None setting.

4 Select to schedule affinity by selecting the **Run on processor(s)** button.

NOTE This option is not allowed when the virtual machine resides on a DRS cluster, and its values are cleared when a virtual machine is migrated to a new host. The value of the option is only in tuning the performance of a precise set of virtual machines on the same host.

The check boxes for the individual processors represent physical cores if hyperthreading is disabled or logical cores (two per physical core) if hyperthreading is enabled. Checking all the boxes is the same as not applying any affinity. You must provide at least as many processor affinities as the number of virtual CPUs in the virtual machine.

5 Click **OK** to save your changes.

The Virtual Machine Properties dialog box closes.

Memory Resources

The Memory Resources panel lets you allocate memory resources for a virtual machine and specify reservations, limits, and shares.

You can edit some of the same information on the Resource Pools tab of the main vSphere Client window, which you might do to edit resource settings at the same time as other virtual machine settings.

Change the Memory Settings of a Virtual Machine

You can select a relative metric for allocating memory to all virtual machines on a host.

Procedure

1 Click the **Resources** tab.

2 Select **Memory** in the **Settings** list.

3 From the drop-down menu in the Resource allocation panel, select a relative metric for allocating memory to all virtual machines.

Symbolic values **Low**, **Normal**, **High**, and **Custom** are compared to the sum of all shares of all virtual machines on the server and, on an ESX host, the service console. Share allocation symbolic values can be used to configure their conversion into numeric values.

4 In the Resource allocation panel, use the slider to select the amount of reserved memory and the memory limit, or use the up and down arrows to enter the number of MBs allocated.

For more information on memory values, see the mem man page.

5 Click **OK** to save your changes.

The Virtual Machine Properties dialog box closes.

Advanced Memory Resources

The Advanced Memory Resources page lets you set low-level options that involve distribution of virtual machine memory to NUMA memory nodes.

This page appears only if the host utilizes the NUMA memory architecture. Because affinity settings are meaningful only when used to tweak the performance of a specific set of virtual machines on one host, this page also is not displayed when the virtual machine resides on a DRS cluster. The option values are cleared when the virtual machine is moved to a new host.

NUMA memory node affinity enables fine-grained control over how virtual machine memory is distributed to host physical memory. Checking all the boxes is the same as applying no affinity.

Consult the *Resource Management Guide* for details about NUMA and advanced memory resources.

NOTE Specify nodes to be used for future memory allocations only if you have also specified CPU affinity. If you make manual changes only to the memory affinity settings, automatic NUMA rebalancing does not work properly.

Associate Memory Allocations with a NUMA Node

Use the **Resources** tab in the Virtual Machine Properties dialog box to associate memory allocations with a NUMA node.

Procedure

1 Select the **Resources** tab, and select **Memory**.

2 In the **NUMA Memory Affinity** panel, set memory affinity.

Disk Resources

The Disk Resources panel lets you allocate host disk I/O bandwidth to the virtual hard disks of this virtual machine.

Disk I/O is a host-centric resource and cannot be pooled across a cluster. However, CPU and memory resources are much more likely to constrain virtual machine performance than disk resources.

Change the Disk Settings of a Virtual Machine

You can adjust the host disk allocation for a virtual machine.

Procedure

1 Click the **Resources** tab.

2 Select **Disk** in the **Settings** list.

3 In the Resource Allocation panel, select the virtual hard disk from the list.

4 Click in the **Shares** field. Use the drop-down menu to change the value to allocate a number of shares of its disk bandwidth to the virtual machine.

   Shares is a value that represents the relative metric for controlling disk bandwidth to all virtual machines. The values Low, Normal, High, and Custom are compared to the sum of all shares of all virtual machines on the server and, on an ESX/ESXi host, the service console. Share allocation symbolic values can be used to configure their conversion into numeric values.

5 Click **OK** to save your changes.

Adding New Hardware

You can add virtual hardware to a virtual machine using the Add Hardware wizard.

The virtual hardware that you add appears in the hardware list displayed in the Virtual Machine Properties wizard. The selected guest operating system determines the devices that are available to add to a given virtual machine.

Virtual machine hardware can be reconfigured while the virtual machine is running, if the following conditions are met:

- The virtual machine has a guest operating system that supports hot-plug functionality. See the *Guest Operating System Installation Guide*.
- The virtual machine is using hardware version 7.
- Virtual CPUs can only be added while the virtual machine is running if CPU Hot Plug has been enabled on the **Options** tab of the Virtual Machine Properties dialog box.

NOTE If a virtual machine is on a host managed by vCenter Server, be sure to connect to vCenter Server when adding or modifying virtual hardware for the virtual machine. If you connect the vSphere Client directly to the host, add hardware operations might fail with the error message `Cannot complete operation due to concurrent modification by another operation`.

Rescan a Host

You rescan a host to ensure that it detects changes made to storage adapter or SAN configuration.

Procedure

1 Select a host.

2 Select the **Configuration** tab.

3 Click **Network Adapters** in the **Hardware** section.

4 Click **Rescan**.

5 Select **New Storage Devices**

6 Click **OK**.

Start the Add Hardware Wizard

The Add Hardware Wizard enables you to reconfigure a virtual machine's hardware.

Procedure

1 In the vSphere Client, click **Inventory** in the navigation bar. Expand the inventory as needed, and click the appropriate virtual machine.

2 To display the Virtual Machine Properties dialog box, click the **Edit Settings** link in the Commands panel.

3 Click the **Hardware** tab.

4 Click **Add** to start the Add Hardware wizard.

Add a Serial Port to a Virtual Machine

When you add a serial port to a virtual machine, you can use a physical serial port on the host, an output file, or a named pipe.

Procedure

1 Start the Add Hardware wizard.

2 Select **Serial Port**, and click **Next**.

3 Select the type of media you want the virtual port to access: use a physical serial port on the host, output to a file, or connect to a named pipe.

4 Click **Next**.

5 If you selected **Use physical serial port on the host**, use the drop-down menu to select the port on the host computer that you want to use for this serial connection.

6 If you selected **Output to file**, browse to the file on the host that you want to use to store the output of the virtual serial port.

7 If you selected **Connect to named pipe**, enter a pipe name in the **Pipe Name** field and use the drop-down menus to select the near and far ends of the pipe.

The options for the near end are client or server. The options for the far end are a process or a virtual machine.

By default, the serial port is connected when you power on the virtual machine.

8 (Optional) Deselect the **Connect at power on** check box if you do not want the serial port to connect when the virtual machine is powered on.

9 (Optional) Deselect the I/O mode **Yield CPU on poll** check box if you want to configure this serial port to use interrupt mode as opposed to polled mode.

Polled mode is of interest primarily to developers who are using debugging tools that communicate over a serial connection. Polled mode causes the virtual machine to consume a disproportionate share of CPU time. This makes the host and other guests run sluggishly.

10 (Optional) To maintain best performance for applications on the host, select the Yield CPU on poll check box.

This forces the affected virtual machine to use interrupt mode, which yields CPU time if the only task it is trying to do is poll the virtual serial port.

11 Review the information on the Ready to Complete page, and click **Finish**.

Add a Parallel Port to a Virtual Machine

When you add a parallel port to a virtual machine, you can use a parallel port on the host or an output file.

Procedure

1 Start the Add Hardware wizard.

2 Select **Parallel Port**, and click **Next**.

3 Select **Use physical parallel port on the host** or **Output to file**, and click **Next**.

4 If you selected **Use physical parallel port on the host**, select the port from the drop-down menu. If you selected **Output to file**, browse to the location of the file.

5 Under **Device status**, deselect the **Connect at power on** check box if you do not want the parallel port device to be connected when the virtual machine powers on.

6 Click **Next**.

7 Review the information on the Ready to Complete page, and click **Finish**.

Add a DVD/CD-ROM Drive to a Virtual Machine

You can use a physical drive on a client or host or you can use an ISO image to add a DVD/CD-ROM drive to a virtual machine.

If you are adding a CD/DVD-ROM drive that is backed by USB CD/DVD drive on the host, you must add the drive as a SCSI device.

Procedure

1 Start the Add Hardware wizard.

2 Select DVD/CD-ROM Drive, and click **Next**.

3 Select either **Use physical drive** or **Use ISO image**.

- If you selected **Use physical drive**, select either client or host as the device location. Select the drive you want to use from the drop-down menu.
- Select **pass through** and use the check box to indicate whether to connect exclusively to the virtual machine, or select **ATAPI emulation**.
- If you selected **Use ISO Image**, enter the path and filename for the image file, or click **Browse** to navigate to the file.

4 If you do not want the CD-ROM drive connected when the virtual machine starts, deselect **Connect at power on**.

5 Click **Next**.

6 Specify the virtual device node the drive uses in the virtual machine, and click **Next**.

7 Review the information on the **Ready to Complete** window, and click **Finish** or Back if you want to change any information.

Add a Floppy Drive to a Virtual Machine

Use a physical floppy drive or a floppy image to add a floppy drive to a virtual machine.

Procedure

1 Start the Add Hardware wizard.

2 Select **Floppy Drive**, and click **Next**.

3 Select the type of floppy media to use:

- A physical floppy drive to give the guest access to the floppy on the host.
- A floppy image, which is a file on the host that stores data in the same format as a physical floppy disk.
- A blank floppy image to create and use a blank floppy image.

4 Click **Next**.

5 Specify the location of the floppy drive or image.

- If you selected **Use a physical floppy drive**, select either client or host as the device location and select the drive from the drop-down menu.
- If you selected **Use a floppy image**, browse to the floppy image.
- If you selected **Create a blank floppy image**, browse to the floppy image.

6 To have the floppy drive connected to the virtual machine when you power it on, select **Connect at power on**.

7 Click **Next**.

8 Review the information on the Ready to Complete page, and click **Finish**.

Add an Ethernet Adapter (NIC) to a Virtual Machine

When you add an Ethernet adapter to a virtual machine, you select the adapter type, the network label and whether the device should connect when the virtual machine is powered on.

Procedure

1 Start the Add Hardware wizard.

2 Select **Ethernet Adapter**, and click **Next**.

3 In the **Adapter Type** section, select a type.

4 In the Network connection panel, select either a named network with a specified label or a legacy network.

5 To connect the virtual NIC when the virtual machine is powered on, select **Connect at power on**.

6 Click **Next**.

7 Review your selections and click **Finish**.

Network Adapter Types

When you configure a virtual machine, you can add network adapters (NICs) and specify the adapter type. The type of network adapters that are available depend on the following factors:

- The version of the virtual machine, which depends on what host created it or most recently updated it.
- Whether or not the virtual machine has been updated to the latest version for the current host.
- The guest operating system.

The following NIC types are supported:

Flexible Supported on virtual machines that were created on ESX Server 3.0 or greater and that run 32-bit guest operating systems. The Flexible adapter functions as a Vlance adapter if VMware Tools is not installed in the virtual machine and as a Vmxnet driver if VMware Tools is installed in the virtual machine.

e1000 Emulates the functioning of an E1000 network card. It is the default adapter type for virtual machines that run 64-bit guest operating systems.

Enhanced vmxnet An upgraded version of the Vmxnet device with enhanced performance. It requires that VMware Tools be installed in the virtual machine.

vmxnet 3 Next generation Vmxnet device with enhanced performance and enhanced networking features. It requires that VMware Tools be installed in the virtual machine, and is available only on virtual machines with hardware version 7 and greater.

Network Adapters and Legacy Virtual Machines

This section discusses network adapters on legacy virtual machines.

If your virtual machine was created on ESX Server 3.0 or greater and runs a 32-bit guest operating system, the default adapter type is Flexible. The Flexible adapter functions as a Vlance adapter if the adapter's driver is the stock driver the guest operating system. The Flexible adapter functions as a vmxnet adapter if the vmxnet driver has been installed on the virtual machine as part of the VMware Tools installation.

If your virtual machine runs a 64-bit guest operating system, the default adapter type is E1000. If you change a virtual machine from a 32-bit to a 64-bit guest operating system, or the reverse, you must remove the existing network adapter and replace it with a new one, or the virtual machine will not power on.

If you do a hardware upgrade on a legacy virtual machine, the adapter type for that upgraded machine is as follows:

- If the adapter type was Vlance, the adapter type on the upgraded virtual machine is Flexible. That adapter functions as a Vlance adapter would function. If you want to obtain significantly better performance, you need only install the VMware Tools on the virtual machine as described in the previous step.
- If the adapter type is vmxnet, the adapter type on the upgraded virtual machine is still vmxnet. However, you cannot change this adapter's type to Vlance, as you would have been able to do on a legacy virtual machine.

Add a Hard Disk to a Virtual Machine

When you add a hard disk to a virtual machine, you can create a new virtual disk, add an existing virtual disk, or add a mapped SAN LUN.

Procedure

1 Start the Add Hardware wizard.

2 Select **Hard Disk**, and click **Next**.

3 Select the type of storage for the virtual machine's disk, and click **Next**.

You can store virtual machine data in a new virtual disk, an existing virtual disk, or a Mapped SAN LUN. A virtual disk, which appears as a single hard disk to the guest operating system, is composed of one or more files on the host file system. Virtual disks can easily be copied or moved on the same host or between hosts.

4 If you selected **Create a new virtual disk**, do the following:

   a Enter the disk capacity.

   b Select the location as either **Store with the virtual machine** or **Specify a datastore**.

   c If you selected **Specify a datastore**, browse for the datastore location, and click **Next**. Continue with Step 7.

5 If you selected an existing disk, browse for the disk file path and click **Next**.

6 If you selected **Mapped SAN LUN**:

   a Select the LUN that you want to use for the raw disk, and click **Next**.

   b Select a datastore and click **Next**.

   c Select the compatibility mode: physical to allow the guest operating system to access the hardware directly or virtual to allow the virtual machine to use VMware snapshots and other advanced functions. Click **Next**.

7 Specify the virtual device node.

8 Set virtual disk mode options:

   a Select **Independent** to make the disk independent. Independent disks are not affected by snapshots.

   b If you selected Independent, select one of the two modes for independent disks:

   - Persistent – The disk operates normally except that changes to the disk are permanent even if the virtual machine is reverted to a snapshot.
   - Nonpersistent – The disk appears to operate normally, but whenever the virtual machine is powered off or reverted to a snapshot, the contents of the disk return to their original state. All later changes are discarded.

9 Click **Next**.

10 Review the information, and click **Finish**.

Add a SCSI Device to a Virtual Machine

You can add a SCSI device to a virtual machine through the Add Hardware wizard.

Procedure

1 Start the Add Hardware wizard.

2 Select **SCSI Device**, and click **Next**.

3 Under **Connection**, use the drop-down menu to select the physical device you want to use.

4 To connect this virtual machine to the server's SCSI device when the virtual machine is powered on, select **Connect at power on**.

5 Under Virtual device node, select the virtual device node where you want this device to appear in the virtual machine.

   You can also select the check box to indicate that the virtual device is set up in the same way as the physical unit.

6 Review the information in the Ready to Complete page, and click **Finish**.

Add a PCI Device

VMDirectPath I/O allows a guest operating system on a virtual machine to directly access physical PCI and PCIe devices connected to a host. Each virtual machine can be connected to up to two PCI devices.

PCI devices connected to a host can be marked as available for passthrough from the Hardware Advanced Settings in the **Configuration** tab for the host.

Prerequisites

To use VMDirectPath, the host must have Intel® Virtualization Technology for Directed I/O (VT-d) or AMD I/O Virtualization Technology (IOMMU) enabled in the BIOS. In order to add PCI devices to a virtual machine, the devices must be connected to the host and marked as available for passthrough. In addition, PCI devices can be added only to virtual machines with hardware version 7.

Procedure

1 Select the virtual machine from the inventory panel and click **Virtual Machine > Edit Settings**.

2 On the Hardware tab, click **Add**.

3 In the Add Hardware wizard, select **PCI Device** and click **Next**.

4 Select the passthrough device to connect to the virtual machine from the drop-down list and click **Next**.

5 Click **Finish**.

Add a Paravirtualized SCSI Adapter

Paravirtual SCSI (PVSCSI) adapters are high-performance storage adapters that can provide greater throughput and lower CPU utilization. PVSCSI adapters are best suited for environments, especially SAN environments, running I/O-intensive applications. PVSCSI adapters are not suited for DAS environments.

Prerequisites

An existing virtual machine with a guest operating system and VMware Tools installed.

Procedure

1 Right-click on the virtual machine and select **Edit Settings**.

2 Click **Add**.

3 Select **SCSI Device** and click **Next**.

4 Select a SCSI device.

5 Select an unused Virtual Device Node.

6 Click **Next**.

7 Review your selections and click **Finish.**

A new SCSI device and a new SCSI controller are created.

8 Select the new SCSI controller and click **Change Type**.

9 Select VMware Paravirtual and click **OK**.

About VMware Paravirtual SCSI Adapters

Paravirtual SCSI (PVSCSI) adapters are high-performance storage adapters that can result in greater throughput and lower CPU utilization. Paravirtual SCSI adapters are best suited for high performance storage environments. Paravirtual SCSI adapters are not suited for DAS environments.

Paravirtual SCSI adapters are available for virtual machines running hardware version 7 and greater. They are supported on the following guest operating systems:

- Windows Server 2008
- Windows Server 2003
- Red Hat Linux (RHEL) 5

The following features are not supported with Paravirtual SCSI adapters:

- on Linux
- Record/Replay
- Fault Tolerance
- MSCS Clustering

Paravirtual SCSI adapters have the following limitations:

- Hot-add and Hot-remove requires a bus rescan from within the guest.
  - (Windows guests) In the Computer Management console, right-click **Storage > Disk Management** and select **Rescan Disks**.
  - (Linux guests) See the Red Hat Linux Web site for the most current instructions.
- Disks on Paravirtual SCSI adapters might not experience performance gains if they have snapshots or if memory on the ESX host is over committed.
- If you upgrade from RHEL 5 to an unsupported kernel, you might not be able to access data on the disks attached to a Paravirtual SCSI adapter. To regain access to such disks, run the VMware Tools configuration (`vmware-config-tools.pl`) with kernel-version parameter and pass the kernel version after the kernel is upgraded and before the virtual machine is rebooted. Run `uname -r` to determine the version of the running kernel.

Converting Virtual Disks from Thin to Thick

If you created a virtual disk in the thin format, you can convert it to thick.

The thin provisioned disk starts small and at first, uses just as much storage space as it needs for its initial operations. You can determine whether your virtual disk is in the thin format and, if required, convert it to thick. After having been converted, the virtual disk grows to its full capacity and occupies the entire datastore space provisioned to it during the disk's creation.

For more information on thin provisioning and disk formats, see *ESX Configuration Guide* or *ESXi Configuration Guide*.

Determine the Disk Format of a Virtual Machine

You can determine whether your virtual disk is in thick or thin format.

Procedure

1 Select the virtual machine in the inventory.

2 Click **Edit Settings** to display the Virtual Machine Properties dialog box.

3 Click the **Hardware** tab and select the appropriate hard disk in the Hardware list.

The Disk Provisioning section on the right shows the type of your virtual disk, either Thin or Thick.

4 Click **OK**.

What to do next

If your virtual disk is in the thin format, you can inflate it to its full size.

Convert a Virtual Disk from Thin to Thick

If you created a virtual disk in the thin format, you can convert it to thick.

Procedure

1 Select the virtual machine in the inventory.

2 Click the **Summary** tab and, under Resources, double-click the datastore for the virtual machine to open the Datastore Browser dialog box.

3 Click the virtual machine folder to find the virtual disk file you want to convert. The file has the `.vmdk` extension.

4 Right-click the virtual disk file and select **Inflate**.

The virtual disk in thick format occupies the entire datastore space originally provisioned to it.

Working with Templates and Clones 14

A template is a master copy of a virtual machine that can be used to create and provision new virtual machines. This image typically includes a specified operating system and configuration that provides virtual counterparts to hardware components. Typically, a template includes an installed guest operating system and a set of applications.

Templates coexist with virtual machines at any level within the template and virtual machine domain. You can order collections of virtual machines and templates into arbitrary folders and apply a variety of permissions to both virtual machines and templates. Virtual machines can be transformed into templates without requiring a full copy of the virtual machine files and the creation of a new object.

You can use templates to create new virtual machines by deploying the template as a virtual machine. When complete, the deployed virtual machine is added to the folder chosen by the user.

To view templates, select the datacenter and click the Virtual Machines tab. All virtual machines and templates for the datacenter are visible from here. Virtual machines and templates have different icons.

This chapter includes the following topics:

- "Creating Templates," on page 169
- "Edit a Template," on page 171
- "Change Template Name," on page 172
- "Deploy Virtual Machines from Templates," on page 172
- "Convert Templates to Virtual Machines," on page 173
- "Deleting Templates," on page 173
- "Regain Templates," on page 174
- "Clone Virtual Machines," on page 174
- "Create a Scheduled Task to Clone a Virtual Machine," on page 175

Creating Templates

Templates can be created by using an existing virtual machine or cloning a virtual machine or existing template.

You can create a template by:

- Using an existing virtual machine in place. This process converts the original virtual machine.
- Cloning a virtual machine to a template.
- Cloning an existing template.

Convert Virtual Machine to Template

You can use an existing virtual machine to convert into a template.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Expand the inventory as needed, and select a virtual machine.

4 Turn off the virtual machine using the shut-down or power-off options.

5 Right-click the virtual machine and select **Convert to Template**.

vCenter Server marks that virtual machine as a template and displays the task in the Recent Tasks pane.

Clone Virtual Machine to Template

You can clone an existing virtual machine into a template.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Power off the virtual machine.

4 Right-click the virtual machine and click **Clone to Template**.

The Clone Virtual Machine to Template wizard appears.

5 Give the new template a name, select its inventory location, and click **Next**.

6 Pass through the target location page and click **Next**.

7 Specify in which format to store the template's virtual disks.

Option	Description
Same as Source	Use the format of the original virtual disk.
Thin Provisioned	Use the thin format to save storage space. The thin virtual disk starts small and at first, uses just as much storage space as it needs for its initial operations. When the virtual disk requires more space, it can grow to its maximum capacity and occupy the entire datastore space originally provisioned to it. Only VMFS datastores version 3 and later support virtual disks in the thin format.
Thick	Allocate a fixed amount of storage space to the virtual disk. The virtual disk in the thick format does not change its size and from the very beginning occupies the entire datastore space provisioned to it.

8 Click **Next**.

9 Click **Finish**.

vCenter Server displays the Tasks inventory panel for reference and adds the cloned template to the list in the information panel.

Clone Existing Template

You can clone an existing virtual machine template.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Select the datacenter that contains the template.

The virtual machines and templates associated with the datacenter appear in the datacenter panel.

4 Right-click the template and select **Clone**.

The Clone Template wizard appears.

5 Give the new template a unique name and description, and click **Next**.

6 Select the host or cluster, and click **Next**.

7 Select a datastore for the template and click **Next**.

8 Specify in which format to store the template's virtual disks:

Option	Description
Same as Source	Use the format of the original virtual disk.
Thin Provisioned	Use the thin format to save storage space. The thin virtual disk starts small and at first, uses just as much storage space as it needs for its initial operations. When the virtual disk requires more space, it can grow to its maximum capacity and occupy the entire datastore space provisioned to it. Only VMFS datastores version 3 and later support virtual disks in the thin format.
Thick	Allocate a fixed amount of storage space to the virtual disk. The virtual disk in thick format does not change its size and from the very beginning occupies the entire datastore space provisioned to it.

9 Click **Next**.

10 Review the information for your new virtual machine and click **Finish**.

You cannot use the new template until the cloning task completes.

vCenter Server adds the cloned template to the list in the **Virtual Machines** tab.

Edit a Template

You can edit templates. You might want to edit templates to upgrade or add applications, or change hardware.

You can edit your template (to upgrade an application, for example). You cannot edit templates as templates. You must convert the template to a virtual machine, edit it, and convert the edited virtual machine to a template.

Procedure

1 Convert the template to a virtual machine.

2 Edit the virtual machine.

3 Convert the virtual machine to a template.

Change Template Name

You can directly change the name of a template.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Right-click the template and select **Rename**.

The name of the virtual machine is now an editable field.

4 Change the name and click outside the field to save your changes.

Deploy Virtual Machines from Templates

This task deploys a virtual machine from an existing template.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Select the datacenter that contains the template, and click the **Virtual Machines** tab.

The virtual machines and templates associated with the datacenter appear in the datacenter panel.

4 Right-click the template, and select **Deploy Virtual Machine from this Template**.

The Deploy Template wizard appears.

5 Give the new virtual machine a name, select a location, and click **Next**.

6 On the **Host / Cluster** page, select the host on which you want to store the template and click **Next**.

7 Select a resource pool (if applicable) in which you want to run the virtual machine, and click **Next**.

Resource pools allow hierarchical management of resources within a host or cluster. Virtual machines and child pools share the resources of their parent pool.

8 Select a datastore for the virtual machine and click **Next**.

You are choosing the datastore in which to store the files for the virtual machine. You should select one that is large enough to accommodate the virtual machine and all of its virtual disk files so that they can all reside in the same place.

The **Advanced** button allows you to store individual files in separate locations. To return to the datastore selection page, click the **Basic** button.

9 In the **Select Guest Customization Option** page, perform one of these actions:

- If you do not want to customize your guest operating system, select **Do not customize** and click **Next**.
- If you want to customize your guest operating system, click one of the other selections as appropriate. You customize guest operating systems through the wizard or by using an existing customization specification that you create.

NOTE Customization is not supported for all guest operating systems. Additionally, some guest operating systems require Microsoft Sysprep tools.

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10 In the Ready to Complete page, review the information for your new virtual machine, select the **Power on the new Virtual Machine after creation** check box if you want to power on the virtual machine immediately, and click **Finish**.

After you click **Finish**, you cannot use or edit the virtual machine until the task completes. This might take several minutes. The virtual machine is added to the datastore.

Convert Templates to Virtual Machines

You can convert a template into a virtual machine.

When a template that resides on a legacy VMFS2 datastore is converted to a virtual machine, the resulting virtual machine must be registered on the host where the template was created. Select this host as the destination for the new virtual machine.

Procedure

1 Start the vSphere Client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Select the datacenter that contains the template.

The virtual machines and templates associated with the datacenter appear in the datacenter panel.

4 Click the **Virtual Machines** tab.

5 Right-click the template and select **Convert to Virtual Machine**.

The template is converted to a virtual machine.

Deleting Templates

You can delete a template by removing it from the inventory or deleting the template from the disk.

Remove Templates from Inventory

This procedure unregisters the template. It does not remove the template files from the datastore.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Select the appropriate template.

4 Right-click the template, and select **Remove from Inventory**.

5 Click **OK** to confirm removing the template from the vCenter Server database.

The template is unregistered from the vCenter Server inventory.

Delete Template from Disk

Deleted templates are permanently removed from the system.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Select the datastore that contains the template, and click the **Virtual Machine** tab.

4 Right-click the template, and select **Delete from Disk**.

5 Click **OK** to confirm removing the template from the vCenter Server database**.**

The template is deleted from the disk and cannot be recovered.

Regain Templates

Templates are associated with hosts, and the only way to regain or register templates after removing and adding a host is to use the datastore browser to locate the template. Then use the inventory wizard to name and register the `.vmtx` file as a template back into vCenter Server.

If you want the template to retain its original name, do not enter a name in the Add to Inventory wizard. vCenter Server will use the original name if the field in the wizard is left blank.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Right-click the datastore that contains the template and select **Browse Datastore**.

4 Browse through the datastore folders to find the `.vmtx` file.

5 Right-click the `.vmtx` file and select **Add to Inventory**.

The Add to Inventory wizard appears.

6 Enter a template machine name, select a location, and click **Next**.

7 Select a host or cluster on which to store the template, and click **Next**.

8 Review your selections, and click **Finish**.

The template is registered to the host. You can view the template from the host's **Virtual Machine** tab.

Clone Virtual Machines

A clone is a copy plus customization of a virtual machine. When you create a clone, vCenter Server provides an option to customize the guest operating system of that virtual machine.

You can place the new clone on any host within any datacenter.

Procedure

1 Start the vSphere Client and log in to the vCenter Server system.

2 From the Home page, click **VMs and Templates**.

3 Expand the inventory as needed, and click the source virtual machine.

4 Power off the virtual machine.

5 Right-click the virtual machine and select **Clone**.

The Clone Virtual Machine wizard appears.

6 Enter a virtual machine name, select a location, and click **Next**.

7 Select a host or cluster on which to run the clone, and click **Next**.

8 If you select a cluster, you must select a specific host within the cluster, and click **Next**.

9 Select a resource pool in which to run the clone, and click **Next**.

10 Select the datastore location where you want to store the virtual machine files, and click **Next**.

11 Click **Advanced** for more options, and click **Next**.

The Select Guest Customization Option page appears. You can choose to customize the guest operating system using the wizard or using an existing customization specification. You can also choose not to customize.

12 Select the appropriate button, and click **Next**.

13 Review your selections, and click **Finish**.

On the Ready to Complete New Virtual Machine page, you can select the check box to power on the new virtual machine after creation. After you click **Finish**, you cannot use or edit the virtual machine until the task completes. If the task involves the creation of a virtual disk, it could take several minutes to complete.

Create a Scheduled Task to Clone a Virtual Machine

This procedure creates a scheduled task to clone a virtual machine.

Procedure

1 Start the vSphere client, and log in to the vCenter Server system.

2 From the Home page, click **Scheduled Tasks**.

3 Select **File > New > Scheduled Task**, or click **New**.

The **Select a Task to Schedule** dialog box appears.

4 Select **Clone a virtual machine** from the drop-down menu, and click **OK**.

The Clone Virtual Machine wizard appears.

5 Select the virtual machine to clone and click **Next**.

6 Follow the wizard through the same steps as those in the previous task in which you cloned a virtual machine.

7 Enter a name and a task description in the text box.

8 Select the frequency of the task.

9 Select **Now** or **Later**. If later, enter the time and date when you want the virtual machine to be deployed, and click **Next**.

To see the calendar, click **Later**, and click the drop-down arrow to select a date from the calendar. A red circle indicates today's date, and a dark circle indicates the scheduled date.

10 Review the information on the Ready to Complete New Virtual Machine page, and click **Finish**.

Optionally, you can select the check box to power on the new virtual machine after it is created.

vCenter Server adds the new task to the scheduled task list and completes it at the designated time. When it is time to perform the task, vCenter Server first verifies that the user who created the task still has permission to complete the task. If the permission levels are not acceptable, vCenter Server sends a message to the log and the task is not performed.

Customizing Guest Operating Systems 15

The Guest Customization wizard lets you create specifications you can use to prepare the guest operating systems of virtual machines to function in a target environment.

You can store specifications in the database to customize the guest operating system of a virtual machine during the cloning or deploying process. Use the Customization Specification Manager to manage customization specifications you create with the Guest Customization wizard.

This chapter includes the following topics:

- "Preparing for Guest Customization," on page 177
- "Customize Windows During Cloning or Deployment," on page 179
- "Customize Linux During Cloning or Deployment," on page 180
- "Create a Customization Specification for Linux," on page 181
- "Create a Customization Specification for Windows," on page 181
- "Managing Customization Specification," on page 183
- "Completing a Guest Operating System Customization," on page 184

Preparing for Guest Customization

Certain tasks must be performed before running the Guest Customization wizard.

You must perform the following tasks before running the Guest Customization wizard.

- Create and configure a virtual machine.
- Make sure that the virtual machine is registered in the vCenter Server inventory.
- Verify that your system meets the virtual hardware requirements for guest customization listed in "Virtual Hardware Requirements for Guest Customization," on page 178.
- Verify that your system meets the operating system requirements for guest customization listed in "Windows Requirements for Guest Customization," on page 178 and "Linux Requirements for Guest Customization," on page 179.
- Understand the naming requirements for a guest operating system as described in "Naming Requirements for a Guest Operating System," on page 179.
- If you are customizing a Windows guest operating system, verify that all required components are installed on the Windows machine where vCenter Server is installed.

NOTE After deploying and customizing nonvolume-licensed versions of Windows XP or Windows 2003, you might need to reactivate your Microsoft operating system on the new virtual machine.

Virtual Hardware Requirements for Guest Customization

This topic describes the virtual machine hardware requirements for customizing the guest operating system.

Guest customization requires that the source virtual machine that you use to create a clone or template has the following:

- VMware Tools installed
- 32-bit or 64-bit hardware corresponding to the 32-bit or 64-bit operating system being installed
- SCSI disks

About SCSI Disks

The guest operating system being customized must reside on a disk attached as SCSI 0:0 node in the virtual machine configuration.

vCenter Server customization operates on the disk attached to the virtual SCSI node with the lowest address on the SCSI controller with the lowest index.

Setting Up SCSI Disks

This section lists the requirements for setting up SCSI disks.

Consider the following requirements when setting up SCSI disks:

- If a virtual machine has mixed IDE and SCSI disks, the first IDE disk is considered the boot disk, and vCenter Server passes it to the customizer. "First" is in controller:device order, that is, ide0:0, ide0:1, scsi0:0, scsi0:1, and so on.
- On a Windows guest operating system, if the virtual machine resides on a host running ESX Server 3.0.x or earlier, both the active partition (the partition containing `boot.ini`) and the system partition (the partition containing the system directory, for example, `\WINNT` or `\WINDOWS`), are on the same virtual disk and attached the SCSI 0:0 virtual SCSI node. It is not a requirement that active and system partitions be the same partition.
- On a Linux guest operating system, if the virtual machine resides on a host running ESX Server 3.0.x or earlier, the virtual disk containing the system partition (the partition containing the `/etc` directory) must reside on the SCSI 0:0 node.

Windows Requirements for Guest Customization

To customize a Windows guest operating system, the virtual machine must meet certain requirements.

The following are the requirements for Windows:

- The guest operating system is not a primary or backup domain controller.
- The clone or template has the Windows versions that is supported for Guest Customization. For a list of Windows operating systems supported for guest customization, see the *vSphere Compatibility Matrixes* at http://www.vmware.com/pdf/vsphere4/r40/vsp_compatibility_matrix.pdf on the VMware vSphere documentation Web site.

  Windows XP Home or Windows NT4 operating system guest customization is not supported.
- The guest operating system has the most recent version of VMware Tools installed.
- The Microsoft Sysprep tools are installed on the vCenter Server system.

  Microsoft Sysprep tools have certain requirements and impose certain restrictions on the source machine.

- If the virtual machine resides on a host running ESX Server 3.0.x or earlier, both the active partition (the partition containing boot.ini) and the system partition (the partition containing the system directory, for example, `\WINNT` or `\WINDOWS`), must be on the same virtual disk.

Linux Requirements for Guest Customization

To customize a Linux guest operating system, the virtual machine must meet certain requirements.

The following are the requirements for Linux:

- The clone or template has the Linux versions that is supported for Guest Customization. For a list of Linux operating systems supported for guest customization, see the *vSphere Compatibility Matrixes* at http://www.vmware.com/pdf/vsphere4/r40/vsp_compatibility_matrix.pdf on the VMware vSphere documentation Web site.
- The guest operating system has the most recent version of VMware Tools installed.
- Perl must be installed in the Linux guest operating system.
- The clone or template has a root volume formatted with an ext2, ext3, or ReiserFS file system.

Naming Requirements for a Guest Operating System

In the Guest Customization wizard, on the Computer Name page, you must specify a name for this instance of a guest operating system. On Linux systems, it is called the host name. The operating system uses this name to identify itself on the network.

You can set the computer name using one of the following options:

Use a specific name	The name can contain alphanumeric characters and the underscore (_) and hyphen (-) characters. It cannot contain periods (.) or blank spaces and cannot be made up of digits only. To ensure that the name is unique, select **Append a numeric value to ensure uniqueness**. This appends a hyphen followed by a numeric value to the virtual machine name. Names are case-insensitive.
Use the virtual machine's name	The computer name that vCenter Server creates is identical to the name of the virtual machine on which the guest operating system is running.
Prompt the user for a name in the Deploy wizard	The vSphere Client populates the Deploy Virtual Machine wizard with a prompt for the computer name after you complete all the steps in the wizard.
Use a custom application configured with vCenter Server to generate a name	Enter a parameter that can be passed to the custom application.

Customize Windows During Cloning or Deployment

In the process of deploying a new virtual machine from a template or cloning an existing virtual machine, you can customize Windows guest operating systems for the virtual machine.

Procedure

1. From the Clone Virtual Machine or Deploy Template wizard, select **Guest Customization**.
2. Type the virtual machine owner's name and organization and click **Next**.
3. Specify the name that will identify the guest operating system on the network and click **Next**.
4. Type the Windows product key for the new guest operating system.

5 (Optional) If you are customizing a server guest operating system:

   a Select **Include Server License Information**.

   b Select either **Per seat** or **Per server**.

   For **Per server**, enter the maximum number of simultaneous connections you want the server to accept.

6 Click **Next**.

7 Type a password for the administrator account, and confirm the password by typing it again.

NOTE You can change the administrator password only if the administrator password on the source Windows virtual machine is blank. If the source Windows virtual machine or template already has a password, the administrator password does not change.

8 To log users into the guest operating system as Administrator, select the check box, and select the number of times to log in automatically.

9 Click **Next**.

10 Select the time zone for the virtual machine and click **Next**.

11 (Optional) On the **Run Once** page, specify commands to be run the first time a user logs into the guest operating system and click **Next**.

12 Select the type of network settings to apply to the guest operating system and click **Next**:

- **Typical settings** allow vCenter Server to configure all network interfaces from a DHCP server.
- **Custom settings** require you to manually configure the network interface settings.

13 Select how the virtual machine will participate in the network by typing the following:

- Workgroup (for example, MSHOME)
- Windows Server Domain: Type the domain, the user name, and the password for a user account that has permission to add a computer to the specified domain.

14 Click **Next**.

15 (Optional) Select Generate New Security ID (SID) and click **Next**.

16 (Optional) Save the customized options as an `.xml` file:

   a Select **Save this customization specification for later use**.

   b Specify the filename for the specification and click **Next**.

17 Click **Finish** to save your changes and exit the Guest Customization wizard.

You return to the Deploy Template or Clone Virtual Machine wizard.

Customize Linux During Cloning or Deployment

In the process of deploying a new virtual machine from a template or cloning an existing virtual machine, you can customize Linux guest operating systems for the virtual machine.

Procedure

1 From the Clone Virtual Machine or Deploy Template wizard, select **Guest Customization**.

2 Specify a host name to identify the guest operating system on the network.

3 Enter the **Domain Name** for the computer and click **Next**.

4 Select the time zone for the virtual machine and click **Next**.

5 Select the type of network settings to apply to the guest operating system and click **Next**:
   - **Typical settings** allow vCenter Server to configure all network interfaces from a DHCP server.
   - **Custom settings** require you to manually configure the network interface settings.
6 Enter DNS and domain settings.
7 (Optional) Save the customized options as an `.xml` file:
   a Select **Save this customization specification for later use**.
   b Specify the filename for the specification, and click **Next**.
8 Click **Finish** to save your changes.

You return to the Deploy Template or Clone Virtual Machine wizard.

Create a Customization Specification for Linux

Use the Guest Customization wizard to save guest operating system settings in a specification that you can apply to virtual machines in your inventory.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.
2 Click **New**.
3 In the Guest Customization wizard, select Linux from the **Target Virtual Machine OS** menu.
4 Under Customization Specification Information, enter a name for the specification and an optional description and click **Next**.
5 Specify a host name to identify the guest operating system on the network.
6 Enter the **Domain Name** for the computer and click **Next**.
7 Select the time zone for the virtual machine and click **Next**.
8 Select the type of network settings to apply to the guest operating system and click **Next**:
   - **Typical settings** allow vCenter Server to configure all network interfaces from a DHCP server.
   - **Custom settings** require you to manually configure the network interface settings.
9 Enter DNS and domain settings.
10 Click **Finish** to save your changes.

The custom specification you created is listed in the Customization Specification Manager, and can be used to customize virtual machine guest operating systems.

Create a Customization Specification for Windows

Use the Guest Customization wizard to save Windows guest operating system settings in a specification that you can apply to virtual machines in your inventory.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.
2 Click **New**.
3 In the Guest Customization wizard, select Windows from the **Target Virtual Machine OS** menu.
4 To use a custom Sysprep Answer File, select the check box.

5 Under Customization Specification Information, enter a name for the specification and an optional description, and click **Next**.

6 Enter the virtual machine owner's name and organization and click **Next**.

This information appears in the guest operating system System Properties.

7 Type the name that will identify the guest operating system on the network and click **Next**.

8 Type the Windows product key for the new guest operating system.

9 (Optional) If you are customizing a server guest operating system:

a Select **Include Server License Information**.

b Select either **Per seat** or **Per server**.

For **Per server**, enter the maximum number of simultaneous connections you want the server to accept.

10 Click **Next**.

11 Type a password for the administrator account, and confirm the password by typing it again.

NOTE You can change the administrator password only if the administrator password on the source Windows virtual machine is blank. If the source Windows virtual machine or template already has a password, the administrator password does not change.

12 To log users into the guest operating system as Administrator, select the check box, and select the number of times to log in automatically.

13 Click **Next**.

14 Select the time zone for the virtual machine and click **Next**.

15 (Optional) On the **Run Once** page, specify commands to be run the first time a user logs into the guest operating system and click **Next**.

16 Select the type of network settings to apply to the guest operating system and click **Next**:

- **Typical settings** allow vCenter Server to configure all network interfaces from a DHCP server.
- **Custom settings** require you to manually configure the network interface settings.

17 Select how the virtual machine will participate in the network and click**Next**.

- Workgroup (for example, MSHOME)
- Windows Server Domain: Type the domain, the user name, and the password for a user account that has permission to add a computer to the specified domain.

18 (Optional) Select Generate New Security ID (SID) and click **Next**.

19 Click **Finish** to save your changes.

The custom specification you created is listed in the Customization Specification Manager. You can use it to customize virtual machine guest operating systems.

Managing Customization Specification

Customization specifications are XML files that contain guest operating system settings for virtual machines. You create customization specifications with the Guest Customization wizard, and manage specifications using the Customization Specification Manager.

vCenter Server saves the customized configuration parameters in the vCenter Server database. If the customization settings are saved, the administrator, and domain administrator, passwords are stored in encrypted format in the database. Because the certificate used to encrypt the passwords is unique to each vCenter Server system, reinstalling vCenter Server, or attaching a new instance of the server the database, invalidates the encrypted passwords. The passwords must be re-entered before they can be used.

Edit Customization Specifications

You can edit existing specifications using the Customization Specification Manager.

Prerequisites

Before you begin, you must have at least one customization specification.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.

2 In the Customization Specification Manager, right-click a specification and select **Edit**.

3 Proceed through the Guest Customization wizard to change specification setting.

Export Customization Specifications

You can export customization specifications and save them as `.xml` files. To apply an exported specification to a virtual machine, import the .xml file using the Customization Specification Manager.

Prerequisites

Before you begin, you must have at least one customization specification.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.

2 In the Customization Specification Manager, right-click a specification and select **Export**.

3 In the **Save As** dialog, enter a file name and location.

4 Click **Save**.

The specification is saved as an `.xml` file to the location you specified.

Remove a Customization Specification

You can remove customization specifications from the Customization Specification Manager.

Prerequisites

Before you begin, you must have at least one customization specification.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.

2 In the Customization Specification Manager, right-click a specification and select **Remove**.

3 In the confirmation dialog box, select **Yes**.

The specification is removed from the list.

Copy a Customization Specification

You can copy an existing customization specification using the Customization Specification Manager.

Prerequisites

Before you begin, you must have at least one customization specification.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.

2 In the Customization Specification Manager, right-click a specification and select **Copy**.

A new specification is created, Copy of<*specification name*>.

Import a Customization Specification

You can import an existing specification using the Customization Specification Manager, and use the specification to customize the guest operating system of a virtual machine.

Prerequisites

Before you begin, you must have at least one customization specification.

Procedure

1 In the vSphere Client, select **View > Management > Customization Specifications Manager**.

2 Click **Import**.

3 From the Open dialog, browse the `.xml` to import and click **Open**.

The imported specification is added to the list of customization specifications.

Completing a Guest Operating System Customization

When a new virtual machine boots for the first time, the final steps of the customization process take place.

This includes the following operations:

1 The guest operating system boots.

If the guest operating system pauses when the new virtual machine boots, it might be waiting for you to correct errors, such as an incorrect product key or invalid user name. Open the virtual machine's console to determine whether the system is waiting for information.

2 The guest operating system runs finalization scripts.

NOTE The virtual machine might reboot a number of times.

The log in page appears when the process is complete.

View the Error Log on Windows

If the new virtual machine encounters customization errors while it is booting, the errors are reported using the guest's system logging mechanism.

Procedure

- Click the Windows Start button and select **Programs > Administrative Tools > Event Viewer**.

Errors are logged to `%WINDIR%\temp\vmware-imc`.

View the Error Log on Linux

If the new virtual machine encounters customization errors while it is booting, the errors are reported using the guest's system logging mechanism.

Procedure

- Navigate to `/var/log/vmware/customization.log`.

Migrating Virtual Machines 16

Migration is the process of moving a virtual machine from one host or storage location to another. Copying a virtual machine creates a new virtual machine. It is not a form of migration.

In vCenter Server, you have the following migration options:

Cold Migration	Moving a powered-off virtual machine to a new host. Optionally, you can relocate configuration and disk files to new storage locations. Cold migration can be used to migrate virtual machines from one datacenter to another.
Migrating a Suspended Virtual Machine	Moving a suspended virtual machine to a new host. Optionally, you can relocate configuration and disk files to new storage location. You can migrate suspended virtual machines from one datacenter to another.
Migration with VMotion	Moving a powered-on virtual machine to a new host. Migration with VMotion allows you to move a virtual machine to a new host without any interruption in the availability of the virtual machine. Migration with VMotion cannot be used to move virtual machines from one datacenter to another.
Migration with Storage VMotion	Moving the virtual disks or configuration file of a powered-on virtual machine to a new datastore. Migration with Storage VMotion allows you to move a virtual machine's storage without any interruption in the availability of the virtual machine.

Both migration of a suspended virtual machine and migration with VMotion are sometimes referred to as "hot migration", because they allow migration of a virtual machine without powering it off. Migration with VMotion is sometimes referred to as "live migration".

You can move virtual machines manually or set up a scheduled task to perform the cold migration.

This chapter includes the following topics:

- "Cold Migration," on page 188
- "Migrating a Suspended Virtual Machine," on page 188
- "Migration with VMotion," on page 188
- "Migration with Storage VMotion," on page 197
- "Migrate a Powered-Off or Suspended Virtual Machine," on page 198
- "Migrate a Powered-On Virtual Machine with VMotion," on page 199
- "Migrate a Virtual Machine with Storage VMotion," on page 200
- "Storage VMotion Command-Line Syntax," on page 202

Cold Migration

Cold migration is the migration of a powered-off virtual machine. With cold migration, you have the option of moving the associated disks from one datastore to another. The virtual machines are not required to be on shared storage.

The virtual machine you want to migrate must be powered off prior to beginning the cold migration process.

CPU compatibility checks do not apply when you migrate a virtual machine with cold migration.

A cold migration consists of the following tasks:

1 The configuration files, including the NVRAM file (BIOS settings), and log files, as well as the disks of the virtual machine, are moved from the source host to the destination host's associated storage area.

2 The virtual machine is registered with the new host.

3 After the migration is completed, the old version of the virtual machine is deleted from the source host.

Migrating a Suspended Virtual Machine

When migrating a suspended virtual machine, you also have the option of moving the associated disks from one datastore to another. The virtual machines are not required to be on shared storage.

Migration of suspended virtual machines is supported in ESX Server 3.x and ESX Server 3i and later only. Virtual machines created using ESX Server 2.x must be powered off before migration.

When you migrate a suspended virtual machine, the new host for the virtual machine must meet CPU compatibility requirements, because the virtual machine must resume executing instructions on the new host.

Migration of a suspended virtual machine consists of the following steps:

1 The configuration files, including the NVRAM file (BIOS settings), log files, and the suspend file as well as the disks of the virtual machine are moved from the source host to the destination host's associated storage area.

2 The virtual machine is registered with the new host.

3 After the migration is completed, the old version of the virtual machine is deleted from the source host.

Migration with VMotion

Migration with VMotion™ allows virtual machine working processes to continue throughout a migration.

The entire state of the virtual machine, as well as its configuration file, if necessary, is moved to the new host, while the associated virtual disk remains in the same location on storage that is shared between the two hosts. After the virtual machine state is migrated to the alternate host, the virtual machine runs on the new host.

The state information includes the current memory content and all the information that defines and identifies the virtual machine. The memory content includes transaction data and whatever bits of the operating system and applications are in the memory. The defining and identification information stored in the state includes all the data that maps to the virtual machine hardware elements, such as BIOS, devices, CPU, MAC addresses for the Ethernet cards, chip set states, registers, and so forth.

When you migrate a virtual machine with VMotion, the new host for the virtual machine must meet compatibility requirements in order for the migration to proceed.

Migration with VMotion happens in three stages:

1 When the migration with VMotion is requested, vCenter Server verifies that the existing virtual machine is in a stable state with its current host.

2 The virtual machine state information (memory, registers, and network connections) is copied to the target host.

3 The virtual machine resumes its activities on the new host.

If any error occurs during migration, the virtual machines revert to their original states and locations.

Migration of a suspended virtual machine and migration with VMotion can be referred to as hot migration, because they allow migration of a virtual machine without powering it off.

Host Configuration for VMotion

In order to successfully use VMotion, you must first configure your hosts correctly.

Ensure that you have correctly configured your hosts in each of the following areas:

- Each host must be correctly licensed for VMotion. For more information on licensing, see the *Installation Guide*.
- Each host must meet shared storage requirements for VMotion.
- Each host must meet the networking requirements for VMotion.

VMotion Shared Storage Requirements

Configure hosts for VMotion with shared storage to ensure that virtual machines are accessible to both source and target hosts.

During a migration with VMotion, the migrating virtual machine must be on storage accessible to both the source and target hosts. Ensure that the hosts configured for VMotion use shared storage. Shared storage is typically on a storage area network (SAN), but can also be implemented using iSCSI and NAS shared storage. See the VMware *SAN Configuration Guide* for additional information on SAN and the *ESX Configuration Guide* or *ESXi Configuration Guide* for information on other shared storage.

VMotion Networking Requirements

Migration with VMotion requires correctly configured network interfaces on source and target hosts.

VMotion requires a Gigabit Ethernet (GigE) network between all VMotion-enabled hosts. Each host enabled for VMotion must have a minimum of two Ethernet adapters, at least one of which must be a GigE adapter.

Recommended networking best practices are as follows:

- Use one dedicated Ethernet adapter for the service console (on ESX hosts).
- Use one dedicated GigE adapter for VMotion.
- If only two Ethernet adapters are available:
  - For best security, dedicate the GigE adapter to VMotion, and use VLANs to divide the virtual machine and management traffic on the other adapter.
  - For best availability, combine both adapters into a bond, and use VLANs to divide traffic into networks: one or more for virtual machine traffic, one for the service console (on ESX hosts), and one for VMotion.

Configure the virtual networks on VMotion-enabled hosts as follows:

- On each host, configure a VMkernel port group for VMotion.
- Ensure that virtual machines have access to the same subnets on source and destination hosts.
- Ensure that the network labels used for virtual machine port groups are consistent across hosts. During a migration with VMotion, vCenter Server assigns virtual machines to port groups based on matching network labels.

- Use of Jumbo Frames is recommended for best VMotion performance.

CPU Compatibility and Migration

vCenter Server performs a number of compatibility checks before allowing migration of running or suspended virtual machines to ensure that the virtual machine is compatible with the target hosts.

VMotion transfers the running state of a virtual machine between underlying ESX/ESXi systems. Successful migration requires that the processors of the target host be able to execute using the equivalent instructions that the processors of the source host were using when the virtual machine was migrated off of the source host. Processor clock speeds and cache sizes, and the number of processor cores can vary, but processors must come from the same vendor class (AMD or Intel) and use compatible feature sets to be compatible for migration with VMotion.

Migrations of suspended virtual machines also require that the virtual machine be able to resume execution on the target host using equivalent instructions.

When you initiate a migration with VMotion or a migration of a suspended virtual machine, the Migrate Virtual Machine wizard checks the destination host for compatibility and produces an error message if there are compatibility problems that will prevent migration.

When a virtual machine is powered on, it determines its available CPU feature set. The virtual machine's CPU feature set is based on the host's CPU feature set. However, some of the host CPU features can be hidden from the virtual machine if the host is part of a cluster using Enhanced VMotion Compatibility (EVC), or if a CPU compatibility mask is applied to the virtual machine.

NOTE VMware, in partnership with CPU and hardware vendors, is working to maintain VMotion compatibility across the widest range of processors. For additional information, search the VMware Knowledge Base for the *VMotion and CPU Compatibility FAQ*.

CPU Compatibility Scenarios

vCenter's CPU compatibility checks compare the features available on the source and target host CPUs. A mismatch in user-level features blocks migration. A mismatch in kernel-level features does not block migration.

When you attempt to migrate a virtual machine with VMotion, one of the following scenarios applies:

- The destination host feature set matches the virtual machine's CPU feature set. CPU compatibility requirements are met, and migration with VMotion proceeds.
- The virtual machine's CPU feature set contains features not supported by the destination host. CPU compatibility requirements are not met, and migration with VMotion cannot proceed.
- The destination host supports the virtual machine's feature set, plus additional user-level features (such as SSE4.1) not found in the virtual machine's feature set. CPU compatibility requirements are not met, and migration with VMotion cannot proceed.
- The destination host supports the virtual machine's feature set, plus additional kernel-level features (such as NX or XD) not found in the virtual machine's feature set. CPU compatibility requirements are met, and migration with VMotion proceeds. The virtual machine retains its CPU feature set as long as it remains powered on, allowing it to migrate freely back to the original host. However, if the virtual machine is rebooted, it acquires a new feature set from the new host, which might cause VMotion incompatibility if you attempt to migrate the virtual machine back to the original host.

CPU Families and Feature Sets

Processors are grouped into families. Processors within a given family generally have similar feature sets.

Processor families are defined by the processor vendors. You can distinguish different processor versions within the same family by comparing the processors' model, stepping level, and extended features. In some cases, processor vendors have introduced significant architectural changes within the same processor family, such as the SSSE3 and SSE4.1 instructions, and NX/XD CPU security features.

By default, vCenter Server identifies mismatches on features accessible to applications as incompatible to guarantee the stability of virtual machines after migrations with VMotion.

Server hardware's CPU specifications will usually indicate whether or not the CPUs contain the features that affect VMotion compatibility. If the specifications of a server or its CPU features are unknown, VMware's bootable CPU identification utility (available for download from the VMware website) can be used to boot a server and determine whether its CPUs contain features such as SSE3, SSSE3, and NX/XD.

For more information on identifying Intel processors and their features, see *Application Note 485: Intel® Processor Identification and the CPUID Instruction*, available from Intel. For more information on identifying AMD processors and their features, see *CPUID Specification*, available from AMD.

NX/XD Considerations

The AMD No eXecute (NX) and the Intel eXecute Disable (XD) technology serve the same security purpose. They mark memory pages as data-only to prevent malicious software exploits and buffer overflow attacks.

Refer to the documentation for your guest operating system to determine whether it supports NX and XD.

In ESX/ESXi 3.0 and later, NX and XD technology is exposed by default for all guest operating systems that can use it (trading off some compatibility for security by default). Hosts that were previously compatible for VMotion in ESX Server 2.x might become incompatible after upgrading to ESX/ESXi 3.0 and later, because the NX or XD is now exposed when it was previously suppressed, but you can use per-virtual machine CPU compatibility masks to restore compatibility.

SSE3 Considerations

Within the Intel P4 and AMD Opteron processor families, VMware places a restriction between processors that do support the SSE3 instructions and processors that do not support the SSE3 instructions. Because they are application level instructions that bypass the virtualization layer, these instructions could cause application instability if mismatched after a migration with VMotion.

SSSE3 Considerations

Within the Intel P4 and Intel Core processor families, VMware places a restriction between processors that do support the SSSE3 instructions and processors that do not support the SSSE3 instructions. Because they are application level instructions that bypass the virtualization layer, these instructions could cause application instability if mismatched after a migration with VMotion.

SSE4.1 Considerations

Within the Intel Core 2 processor family, VMware places a restriction between processors that do support the SSE4.1 instructions and processors that do not support the SSE4.1 instructions because they are application level instructions that bypass the virtualization layer, and could cause application instability if mismatched after a migration with VMotion.

About Enhanced VMotion Compatibility

You can use the Enhanced VMotion Compatibility (EVC) feature to help ensure VMotion compatibility for the hosts in a cluster. EVC ensures that all hosts in a cluster present the same CPU feature set to virtual machines, even if the actual CPUs on the hosts differ. Using EVC prevents migrations with VMotion from failing because of incompatible CPUs.

Configure EVC from the cluster settings dialog box. When you configure EVC, you configure all host processors in the cluster to present the feature set of a baseline processor. EVC leverages AMD-V Extended Migration technology (for AMD hosts) and Intel FlexMigration technology (for Intel hosts) to mask processor features so that hosts can present the feature set of an earlier generation of processors. The baseline feature set must be equivalent to, or a subset of, the feature set of the host with the smallest feature set in the cluster.

EVC masks only those processor features that affect VMotion compatibility. Enabling EVC does not prevent a virtual machine from taking advantage of faster processor speeds, increased numbers of CPU cores, or hardware virtualization support that might be available on newer hosts.

EVC cannot prevent virtual machines from accessing hidden CPU features in all circumstances. Applications that do not follow CPU vendor recommended methods of feature detection might behave unexpectedly in an EVC environment. VMware EVC cannot be supported with ill-behaved applications that do not follow the CPU vendor recommendations. For more information about creating well-behaved applications, search the VMware Knowledge Base for the article *Detecting and Using New Features in CPUs*.

EVC Requirements

Hosts in an EVC cluster must meet certain requirements.

To enable EVC on a cluster, the cluster must meet the following requirements:

- You must be running vCenter Server 2.5 Update 2 or later.
- All virtual machines in the cluster that are running on hosts with a feature set greater than the EVC mode you intend to enable must be powered off or migrated out of the cluster before EVC is enabled. (For example, consider a cluster containing an Intel Xeon Core 2 host and an Intel Xeon 45nm Core 2 host, on which you intend to enable the Intel Xeon Core 2 baseline. The virtual machines on the Intel Xeon Core 2 host can remain powered on, but the virtual machines on the Intel Xeon 45nm Core 2 host must be powered off or migrated out of the cluster.)
- All hosts in the cluster must have CPUs from a single vendor, either AMD or Intel.
- All hosts in the cluster must be running ESX/ESXi 3.5 Update 2 or later.

- All hosts in the cluster must be connected to the vCenter Server system.
- All hosts in the cluster must have advanced CPU features, such as hardware virtualization support (AMD-V or Intel VT) and AMD No eXecute (NX) or Intel eXecute Disable (XD), enabled in the BIOS if they are available.
- All hosts in the cluster should be configured for VMotion. See "Host Configuration for VMotion," on page 189.
- All hosts in the cluster must have supported CPUs for the EVC mode you want to enable. For specific host processors supported, see Table 16-1.

Any host added to an existing EVC-enabled cluster must also meet the requirements listed above.

NOTE Hardware vendors sometimes disable particular CPU features in the BIOS by default. This can cause problems in enabling EVC, because the EVC compatibility checks do not detect features that are expected to be present for a particular CPU. If you cannot enable EVC on a system with a compatible processor, ensure that all features are enabled in the BIOS.

Table 16-1 lists the processors supported in EVC Clusters.

Table 16-1. Processors Supported in EVC Clusters

Vendor	EVC Mode	Processors Supported
AMD	AMD Opteron Generation 1	AMD Opteron Generation 1
		AMD Opteron Generation 2
		AMD Opteron Generation 3
	AMD Opteron Generation 2	AMD Opteron Generation 2
		AMD Opteron Generation 3
	AMD Opteron Generation 3	AMD Opteron Generation 3
Intel	Intel Xeon Core 2	Intel Xeon Core 2
		Intel Xeon 45nm Core 2
		Intel Xeon Core i7
		Intel Xeon 32nm Core i7
	Intel Xeon 45nm Core 2	Intel Xeon 45nm Core 2
		Intel Xeon Core i7
		Intel Xeon 32nm Core i7
	Intel Xeon Core i7	Intel Xeon Core i7
		Intel Xeon 32nm Core i7
	Intel Xeon 32nm Core i7	Intel Xeon 32nm Core i7

Create an EVC Cluster

Create an EVC cluster to help ensure VMotion compatibility between the hosts in the cluster.

When you create an EVC cluster, use one of the following methods:

- Create an empty cluster, enable EVC, and move hosts into the cluster.
- Enable EVC on an existing cluster.

VMware recommends creating an empty EVC cluster as the simplest way of creating an EVC cluster with minimal disruption to your existing infrastructure.

Prerequisites

Before you create an EVC cluster, ensure that the hosts you intend to add to the cluster meet the requirements listed in "EVC Requirements," on page 192.

Procedure

1 Create an empty cluster, and enable EVC.

Select the CPU vendor and feature set appropriate for the hosts you intend to add to the cluster. For information on configuring EVC, see the vSphere Client online Help.

Other cluster features such as VMware DRS and VMware HA are fully compatible with EVC. You can enable these features when you create the cluster. For information on specific cluster options, see the vSphere Client online Help.

2 Select a host to move into the cluster.

3 If the host feature set is greater than the baseline feature set that you have enabled for the EVC cluster, do one of the following:

- Power off all the virtual machines on the host.
- Migrate the host's virtual machines to another host using VMotion.

4 Move the host into the cluster.

You can power on the virtual machines on the host, or migrate virtual machines into the cluster with VMotion, if the virtual machines meet CPU compatibility requirements for the cluster's baseline feature set. Virtual machines running on hosts with more features than the EVC cluster baseline must be powered off before migration into the cluster.

5 Repeat Step 3 and Step 4 for each additional host that you want to move into the cluster.

Enable EVC on an Existing Cluster

Enable EVC on an existing cluster to help ensure VMotion compatibility between the hosts in the cluster.

Prerequisites

Before you enable EVC on an existing cluster, ensure that the hosts in the cluster meet the requirements listed in "EVC Requirements," on page 192.

Procedure

1 Select the cluster for which you want to enable EVC.

2 If virtual machines are running on hosts that have feature sets greater than the baseline feature set you intend to enable, do one of the following tasks:

- Power off all the virtual machines on the hosts with feature sets greater than the EVC baseline.
- Migrate the cluster's virtual machines to another host using VMotion.

  Because these virtual machines are running with more features than the EVC cluster baseline you intend to set, power off the virtual machines to migrate them back into the cluster after enabling EVC.

3 Ensure that the cluster contains hosts with CPUs from only one vendor, either Intel or AMD.

4 Edit the cluster settings and enable EVC.

Select the CPU vendor and feature set appropriate for the hosts in the cluster.

5 If you powered off or migrated virtual machines out of the cluster, power on the virtual machines in the cluster, or migrate virtual machines into the cluster.

Any virtual machines running at a higher baseline than the EVC mode you enabled for the cluster must be powered off before they can be moved back into the cluster.

Change the EVC Mode for an Existing Cluster

If all the hosts in a cluster are compatible with the new mode, you can change the EVC mode of an existing EVC cluster. You can raise the EVC mode to expose more CPU features, or lower the EVC mode to hide CPU features and increase compatibility.

To raise the EVC mode from a CPU baseline with fewer features to one with more features, you do not need to turn off any running virtual machines in the cluster. Virtual machines that are running do not have access to the new features available in the new EVC mode until they are powered off and powered back on. A full power cycling is required. Rebooting the guest operating system or suspending and resuming the virtual machine is not sufficient.

To lower the EVC mode from a CPU baseline with more features to one with fewer features, you must first power off the virtual machines in the cluster, and power them back on after the new mode has been enabled.

Prerequisites

If you intend to lower the EVC mode, power off the currently running virtual machines in the cluster.

Procedure

1 Display the cluster in the inventory.

2 Right-click the cluster and select **Edit Settings**.

3 In the left panel, select **VMware EVC**.

The dialog box displays the current EVC settings.

4 To edit the EVC settings, click **Change**.

5 From the **VMware EVC Mode** drop-down menu, select the baseline CPU feature set you want to enable for the cluster.

If the selected EVC Mode cannot be selected, the Compatibility pane displays the reason or reasons why, along with the relevant hosts for each reason.

6 Click **OK** to close the EVC Mode dialog box, and click **OK** to close the cluster settings dialog box.

CPU Compatibility Masks

CPU compatibility masks allow per-virtual machine customization of the CPU features visible to a virtual machine.

vCenter Server compares the CPU features available to a virtual machine with the CPU features of the destination host to determine whether to allow or disallow migrations with VMotion.

Default values for the CPU compatibility masks are set by VMware to guarantee the stability of virtual machines after a migration with VMotion.

In some cases, where a choice between CPU compatibility or guest operating system features (such as NX/XD) exists, VMware provides check-box options to configure individual virtual machines through the virtual machine's Advanced Settings option. For more control over the visibility of CPU features, you can edit the virtual machine's CPU compatibility mask at the bit level.

CAUTION Manual edit of the CPU compatibility masks without the appropriate documentation and testing might lead to an unsupported configuration.

CPU compatibility masks cannot prevent virtual machines from accessing masked CPU features in all circumstances. In some circumstances, applications can detect and use masked features even though they are hidden from the guest operating system. In addition, on any host, applications that use unsupported methods of detecting CPU features rather than using the CPUID instruction can access masked features. Virtual machines running applications that use unsupported CPU detection methods might experience stability problems after migration.

Virtual Machine Configuration Requirements for VMotion

A number of specific virtual machine configurations can prevent migration of a virtual machine with VMotion.

The following virtual machine configurations can prevent migration with VMotion:

- You cannot use migration with VMotion to migrate virtual machines using raw disks for clustering purposes.
- You cannot use migration with VMotion to migrate a virtual machine that uses a virtual device backed by a device that is not accessible on the destination host. (For example, you cannot migrate a virtual machine with a CD drive backed by the physical CD drive on the source host.) Disconnect these devices before migrating the virtual machine.
- You cannot use migration with VMotion to migrate a virtual machine that uses a virtual device backed by a device on the client computer. Disconnect these devices before migrating the virtual machine.

Swapfile Location Compatibility

Virtual machine swapfile location affects VMotion compatibility in different ways depending on the version of ESX/ESXi running on the virtual machine's host.

Virtual machines on hosts running ESX Server 3.0.x have a virtual machine swap file located with the virtual machine configuration file. Virtual machines on these hosts can be migrated with VMotion only if the destination host can access the VMFS volume where the swap file is located.

You can configure ESX 3.5 or ESXi 3.5 or later hosts to store virtual machine swapfiles in one of two locations: with the virtual machine configuration file, or on a local swapfile datastore specified for that host. You can also set individual virtual machines to have a different swapfile location from the default set for their current host.

The location of the virtual machine swapfile affects VMotion compatibility as follows:

- Migrations between hosts running ESX/ESXi version 3.5 and later: Migrations with VMotion and migrations of suspended and powered-off virtual machines are allowed.

  During a migration with VMotion, if the swapfile location specified on the destination host differs from the swapfile location specified on the source host, the swapfile is copied to the new location. This can result in slower migrations with VMotion. If the destination host cannot access the specified swapfile location, it stores the swapfile with the virtual machine configuration file.

- Migrations between a host running ESX/ESXi version 3.5 and later and a host running an earlier version of ESX Server: Migrations of suspended and powered-off virtual machines are allowed. If the virtual machine is configured to use a local swapfile datastore, attempting to migrate it to a host that does not support this configuration produces a warning, but the migration can proceed. When the virtual machine is powered on again, the swapfile is located with the virtual machine.

  Migrations with VMotion are not allowed unless the destination swapfile location is the same as the source swapfile location. In practice, this means that virtual machine swapfiles must be located with the virtual machine configuration file.

See the vSphere Client online Help for more information on configuring swapfile policies.

Migrating Virtual Machines with Snapshots

Migration of virtual machines with snapshots is possible if the virtual machine resides on shared storage accessible to source and destination hosts.

Some restrictions apply when migrating virtual machines with snapshots. You cannot migrate a virtual machine with snapshots with Storage VMotion. Otherwise, migrating a virtual machine with snapshots is permitted, regardless of the virtual machine power state, as long as the virtual machine is being migrated to a new host without moving its configuration file or disks. (The virtual machine must reside on shared storage accessible to both hosts.)

If the migration involves moving the configuration file or virtual disks, the following additional restrictions apply:

- The starting and destination hosts must be running ESX 3.5 or ESXi 3.5 or later.
- All of the virtual machine files and disks must reside in a single directory, and the migrate operation must move all the virtual machine files and disks to a single destination directory.

Reverting to a snapshot after migration with VMotion might cause the virtual machine to fail, because the migration wizard cannot verify the compatibility of the virtual machine state in the snapshot with the destination host. Failure occurs only if the configuration in the snapshot uses devices or virtual disks that are not accessible on the current host, or if the snapshot contains an active virtual machine state that was running on hardware that is incompatible with the current host CPU.

Migration with Storage VMotion

Using Storage VMotion, you can migrate a virtual machine and its disk files from one datastore to another while the virtual machine is running.

You can choose to place the virtual machine and all its disks in a single location, or select separate locations for the virtual machine configuration file and each virtual disk. The virtual machine does not change execution host during a migration with Storage VMotion.

During a migration with Storage VMotion, you can transform virtual disks from thick-provisioned to thin-provisioned or from thin-provisioned to thick-provisioned.

Storage VMotion has a number of uses in administering virtual infrastructure, including the following examples of use:

- Upgrading ESX/ESXi without virtual machine downtime. During an upgrade from ESX Server 2.x to ESX/ESXi 3.5 or later, you can migrate running virtual machines from a VMFS2 datastore to a VMFS3 datastore, and upgrade the VMFS2 datastore without any impact on virtual machines. You can then use Storage VMotion to migrate virtual machines back to the original datastore without any virtual machine downtime.
- Storage maintenance and reconfiguration. You can use Storage VMotion to move virtual machines off of a storage device to allow maintenance or reconfiguration of the storage device without virtual machine downtime.
- Redistributing storage load. You can use Storage VMotion to manually redistribute virtual machines or virtual disks to different storage volumes to balance capacity or improve performance.

Storage VMotion Requirements and Limitations

A virtual machine and its host must meet resource and configuration requirements for the virtual machine disks to be migrated with Storage VMotion.

Storage VMotion is subject to the following requirements and limitations:

- Virtual machines with snapshots cannot be migrated using Storage VMotion.

- Virtual machine disks must be in persistent mode or be raw device mappings (RDMs). For virtual compatibility mode RDMs, you can migrate the mapping file or convert to thick-provisioned or thin-provisioned disks during migration as long as the destination is not an NFS datastore. For physical compatibility mode RDMs, you can migrate the mapping file only.
- Migration of virtual machines during VMware Tools installation is not supported.
- The host on which the virtual machine is running must have a license that includes Storage VMotion.
- ESX/ESXi 3.5 hosts must be licensed and configured for VMotion. ESX/ESXi 4.0 and later hosts do not require VMotion configuration in order to perform migration with Storage VMotion.
- The host on which the virtual machine is running must have access to both the source and target datastores.
- A particular host can be involved in up to two migrations with VMotion or Storage VMotion at one time.
- vSphere supports a maximum of eight simultaneous VMotion, cloning, deployment, or Storage VMotion accesses to a single VMFS3 datastore, and a maximum of four simultaneous VMotion, cloning, deployment, or Storage VMotion accesses to a single NFS or VMFS2 datastore. A migration with VMotion involves one access to the datastore. A migration with Storage VMotion involves one access to the source datastore and one access to the destination datastore.

Migrate a Powered-Off or Suspended Virtual Machine

You can use the Migration wizard to migrate a powered-off virtual machine or suspended virtual machine.

Procedure

1 Display the virtual machine you want to migrate in the inventory.

2 Right-click on the virtual machine and select **Migrate** from the pop-up menu.

3 Select whether to change the virtual machine's host, datastore, or both.

Option	Description
Change host	Move the virtual machine to another host.
Change datastore	Move the virtual machine's configuration file and virtual disks.
Change both host and datastore	Move the virtual machine to another host and move its configuration file and virtual disks.

4 To move the virtual machine to another host, select the destination host or cluster for this virtual machine migration and click **Next**.

Any compatibility problem appears in the Compatibility panel. Fix the problem, or select another host or cluster.

Possible targets include hosts and DRS clusters with any level of automation. If a cluster has no DRS enabled, select a specific host in the cluster rather than selecting the cluster itself.

5 Select the destination resource pool for the virtual machine migration and click **Next**.

6 If you chose to move the virtual machine's configuration file and virtual disks, select the destination datastore:

- To move the virtual machine configuration files and virtual disks to a single destination, select the datastore and click **Next**.
- To select individual destinations for the configuration file and each virtual disk, click **Advanced**. In the **Datastore** column, select a destination for the configuration file and each virtual disk, and click **Next**.

7 If you chose to move the virtual machine's configuration file and virtual disks, select a disk format and click **Next**.

Option	Description
Same as Source	Use the format of the original virtual disk. If you select this option for an RDM disk in either physical or virtual compatibility mode, only the mapping file is migrated.
Thin provisioned	Use the thin format to save storage space. The thin virtual disk uses just as much storage space as it needs for its initial operations. When the virtual disk requires more space, it can grow in size up to its maximum allocated capacity. This option is not available for RDMs in physical compatibility mode. If you select this option for a virtual compatibility mode RDM, the RDM is converted to a virtual disk. RDMs converted to virtual disks cannot be converted back to RDMs.
Thick	Allocate a fixed amount of hard disk space to the virtual disk. The virtual disk in the thick format does not change its size and from the beginning occupies the entire datastore space provisioned to it. This option is not available for RDMs in physical compatibility mode. If you select this option for a virtual compatibility mode RDM, the RDM is converted to a virtual disk. RDMs converted to virtual disks cannot be converted back to RDMs.

Disks are converted from thin to thick format or thick to thin format only when they are copied from one datastore to another. If you leave a disk in its original location, the disk format is not converted, regardless of the selection made here.

8 Review the summary and click **Finish**.

vCenter Server moves the virtual machine to the new host. Event messages appear in the Events tab. The data displayed on the Summary tab shows the status and state throughout the migration. If errors occur during migration, the virtual machines revert to their original states and locations.

Migrate a Powered-On Virtual Machine with VMotion

You can use the Migration wizard to migrate a powered-on virtual machine from one host to another using VMotion technology. To relocate the disks of a powered-on virtual machine, migrate the virtual machine using Storage VMotion.

Prerequisites

Before migrating a virtual machine with VMotion, ensure that your hosts and virtual machines meet the requirements for migration with VMotion.

- "Host Configuration for VMotion," on page 189
- "Virtual Machine Configuration Requirements for VMotion," on page 196

Procedure

1 Display the virtual machine you want to migrate in the inventory.

2 Right-click on the virtual machine, and select **Migrate** from the pop-up menu.

3 Select **Change host** and click **Next**.

4 Select a destination host or cluster for the virtual machine.

Any compatibility problem appears in the Compatibility panel. Fix the problem, or select another host or cluster.

Possible targets include hosts and fully automated DRS clusters. You can select a non-automated cluster as a target. You are prompted to select a host within the non-automated cluster.

5 Select a resource pool and click **Next**.

6 Select the migration priority level and click **Next**.

Option	Description
High Priority	vCenter Server reserves resources on both the source and destination hosts to maintain virtual machine availability during the migration. High priority migrations do not proceed if resources are unavailable.
Low Priority	vCenter Server does not reserve resources on the source and destination hosts to maintain availability during the migration. Low priority migrations always proceed. However, the virtual machine might become briefly unavailable if host resources are unavailable during the migration.

7 Review the page and click **Finish**.

A task is created that begins the virtual machine migration process.

Migrate a Virtual Machine with Storage VMotion

Use migration with Storage VMotion to relocate a virtual machine's configuration file and virtual disks while the virtual machine is powered on.

You cannot change the virtual machine's execution host during a migration with Storage VMotion.

Procedure

1 Display the virtual machine you want to migrate in the inventory.

2 Right-click on the virtual machine, and select **Migrate** from the pop-up menu.

3 Select **Change datastore** and click **Next**.

4 Select a resource pool and click **Next**.

5 Select the destination datastore:

- To move the virtual machine configuration files and virtual disks to a single destination, select the datastore and click **Next**.
- To select individual destinations for the configuration file and each virtual disk, click **Advanced**. In the **Datastore** column, select a destination for the configuration file and each virtual disk, and click **Next**.

6 Select a disk format and click **Next**:

Option	Description
Same as Source	Use the format of the original virtual disk. If you select this option for an RDM disk in either physical or virtual compatibility mode, only the mapping file is migrated.
Thin provisioned	Use the thin format to save storage space. The thin virtual disk uses just as much storage space as it needs for its initial operations. When the virtual disk requires more space, it can grow in size up to its maximum allocated capacity. This option is not available for RDMs in physical compatibility mode. If you select this option for a virtual compatibility mode RDM, the RDM is converted to a virtual disk. RDMs converted to virtual disks cannot be converted back to RDMs.
Thick	Allocate a fixed amount of hard disk space to the virtual disk. The virtual disk in the thick format does not change its size and from the beginning occupies the entire datastore space provisioned to it. This option is not available for RDMs in physical compatibility mode. If you select this option for a virtual compatibility mode RDM, the RDM is converted to a virtual disk. RDMs converted to virtual disks cannot be converted back to RDMs.

Disks are converted from thin to thick format or thick to thin format only when they are copied from one datastore to another. If you choose to leave a disk in its original location, the disk format is not converted, regardless of the selection made here.

7 Review the page and click **Finish**.

A task is created that begins the virtual machine migration process.

About Migration Compatibility Checks

During migration, the Migrate Virtual Machine wizard checks the destination host for compatibility with the migrating virtual machine using a number of criteria.

When you select a host, the **Compatibility** panel at the bottom of the Migrate Virtual Machine wizard displays information about the compatibility of the selected host or cluster with the virtual machine's configuration.

If the virtual machine is compatible, the panel displays the message, `Validation succeeded`. If the virtual machine is not compatible with either the host's or cluster's configured networks or datastores, the compatibility window can display both warnings and errors:

- Warning messages do not disable migration. Often the migration is justified and you can continue with the migration despite the warnings.
- Errors can disable migration if there are no error-free destination hosts among the selected destination hosts. In this case, the **Next** button is disabled.

For clusters, the network and datastore configurations are taken into account when checking compatibility issues. For hosts, the individual host's configuration is used. A possible problem might be that VMotion is not enabled on one or both hosts.

A specific host CPU feature's effects on compatibility are dependent on whether ESX/ESXi exposes or hides them from virtual machines.

- Features that are exposed to virtual machines are not compatible when they are mismatched.
- Features that are not exposed to virtual machines are compatible regardless of mismatches.

Specific items of virtual machine hardware can also cause compatibility issues. For example, a virtual machine using an enhanced vmxnet virtual NIC cannot be migrated to a host running a version of ESX that does not support enhanced vmxnet.

Storage VMotion Command-Line Syntax

In addition to using the Migration wizard, you can initiate migrations with Storage VMotion from the vSphere Command-Line Interface (vSphere CLI) using the `svmotion` command.

For more information about installing and using the vSphere CLI, see *vSphere Command-Line Interface Installation and Reference*.

You can run the `svmotion` command in either interactive or noninteractive mode.

- To use the command in interactive mode, type **`svmotion --interactive`**. You are prompted for all the information necessary to complete the storage migration. When the command is invoked in interactive mode, all other parameters given are ignored.
- In noninteractive mode, the `svmotion` command uses the following syntax:

  ```
  svmotion [Standard CLI options] --datacenter=<datacenter name> --vm '<VM config datastore path>:<new datastore>' [--disks '<virtual disk datastore path>:<new datastore>, <virtual disk datastore path>:<new datastore>]'
  ```

Square brackets indicate optional elements.

On Windows systems, use double quotes instead of single quotes around the values specified for the `--vm` and `--disks` options.

For more information on the standard CLI options, see the *vSphere Command-Line Interface Installation and Reference*.

Table 16-2 describes the parameters for the `svmotion` command.

Table 16-2. `svmotion` Command Parameters

Parameter	Description
<datacenter>	The datacenter that contains the virtual machine to be migrated. You must quote the name if it contains white space or other special characters.
<VM config datastore path>	The datastore path to the virtual machine's configuration file. If the path contains white space or other special characters, you must quote it.
<new datastore>	The name of the new datastore to which the virtual machine configuration file or disk is to be moved. Do not include brackets around the name of the new datastore.
`--disks`	If you do not specify this parameter, all virtual disks associated with a virtual machine are relocated to the same datastore as the virtual machine configuration file. By specifying this parameter, you can choose to locate individual virtual disks to different datastores. To keep a virtual disk on its current datastore, use the `--disks` option for that disk with its current datastore as the *<new datastore>*.
<virtual disk datastore path>	The datastore path to the virtual disk file.

Determine the Path to a Virtual Machine Configuration File

The path to the virtual machine configuration file is a necessary argument to the `svmotion` command.

You must specify the datastore path to the virtual machine's configuration file in the *<VM config datastore path>* `svmotion` command.

Procedure

1 In the vSphere Client inventory, select the virtual machine and click the **Summary** tab.

2 Click **Edit Settings** to display the Virtual Machine Properties dialog box.

3 Click the **Options** tab, and select **General Options**.

The path to the virtual machine configuration file appears in the **Virtual Machine Configuration File** text box.

Determine the Path to a Virtual Disk File

You must specify the virtual disk datastore path as part of the `svmotion` command.

Procedure

1 In the vSphere Client inventory, select the virtual machine to which the virtual disk belongs, and click the **Summary** tab.

2 Click **Edit Settings** to display the Virtual Machine Properties dialog box.

3 Click the **Hardware** tab, and select the virtual disk from the list of devices.

The path to the virtual disk file appears in the **Disk File** text box.

Storage VMotion Examples

The examples show how to use the Storage VMotion command-line interface to relocate a virtual machine and all its disks, or to relocate the virtual machine configuration file while leaving the disks in place.

The examples in this section are formatted on multiple lines for readability. The command should be issued on a single line.

An example of relocating all of a virtual machine's disks to a datastore named `new_datastore`:

```
svmotion --url=https://myvc.mycorp.com/sdk
         --username=me
         --password=secret
         --datacenter=DC1
         --vm='[old_datastore] myvm/myvm.vmx: new_datastore'
```

An example of relocating a virtual machine to `new_datastore`, while leaving the disks, `myvm_1.vmdk` and `myvm_2.vmdk` on `old_datastore`:

```
svmotion --datacenter='My DC'
         --vm='[old_datastore] myvm/myvm.vmx:
               new_datastore'
         --disks='[old_datastore] myvm/myvm_1.vmdk:
                  old_datastore,
                  [old_datastore] myvm/myvm_2.vmdk:
                  old_datastore'
```

17 Using Snapshots

Snapshots are useful when you need to revert repeatedly to the same state but you do not want to create multiple virtual machines. With snapshots, you can create restore positions in a linear process. You can also preserve a baseline before diverging a virtual machine in a process tree.

You can use a snapshot as a restoration point during a linear or iterative process, such as installing update packages, or during a branching process, such as installing different versions of a program. Taking snapshots ensures that each installation begins from an identical baseline.

This chapter includes the following topics:

- "About Snapshots," on page 205
- "Using the Snapshot Manager," on page 208
- "Restore a Snapshot," on page 209

About Snapshots

A snapshot captures the entire state of the virtual machine at the time you take the snapshot.

Snapshots are useful when you need to revert repeatedly to the same state but you don't want to create multiple virtual machines.

A snapshot includes the following information:

- Contents of the virtual machine's memory
- Virtual machine settings
- State of all the virtual machine's virtual disks

NOTE VMware does not support snapshots of raw disks, RDM physical mode disks, independent disks, or of virtual machines configured with bus-sharing.

If you require bus-sharing, consider running backup software within your guest operating system as an alternative solution. If your virtual machine currently has snapshots and it is preventing you from configuring bus-sharing, delete the snapshots.

Snapshots operate on individual virtual machines. In a team of virtual machines, taking a snapshot preserves the state only of the active virtual machine. When you revert to a snapshot, you return all these items to the state they were in at the time you took that snapshot. If you want the virtual machine to be suspended, powered on, or powered off when you launch it, make sure that it is in the correct state when you take that snapshot.

While snapshots provide a point-in-time image of the disk that backup solutions can use, do not use snapshots for your own virtual machine backups. Large numbers of snapshots are difficult to manage, take up large amounts of disk space, and are not protected in the case of hardware failure.

Because you cannot revert to a snapshot with dynamic disks, quiesced snapshots are not used when backing up dynamic disks.

Backup solutions, like VMware Data Recovery, use the snapshot mechanism to freeze the state of a virtual machine. However, the Data Recovery backup method has additional capabilities that mitigate the limitations of snapshots.

Multiple snapshots refers to the ability to create more than one snapshot of the same virtual machine.

Multiple snapshots are not simply a way of saving your virtual machines. With multiple snapshots, you can save many positions to accommodate many kinds of work processes.

When taking a snapshot, the state of the virtual disk at the time the snapshot is taken will be preserved. When this occurs, the guest cannot write to the `vmdk` file. The delta disk is an additional `vmdk` file to which the guest is allowed to write. The delta disk represents the difference between the current state of the virtual disk and the state that existed at the time the previous snapshot was taken. If more than one snapshot exists, delta disks can represent the difference (or delta) between each snapshot. For example, a snapshot can be taken, and then the guest could write to every single block of the virtual disk, causing the delta disk to grow as large as the entire virtual disk.

When a snapshot is deleted, the changes between snapshots and previous disk states are merged, and all the data from the delta disk that contains the information about the deleted snapshot is written to the parent disk and merges with the base disk only when you choose to do so. This can involve a large amount of disk input and output. This may reduce the virtual machine performance until consolidation is complete.

The amount of time it takes to commit or delete snapshots depends on how much data the guest operating system has written to the virtual disks since the last snapshot was taken. The required time is directly proportional to the amount of data (committed or deleted) and the amount of RAM allocated to the virtual machine.

For additional information about snapshot behavior, see the Knowledge Base article at http://kb.vmware.com/kb/1015180.

Relationship Between Snapshots

The relationship between snapshots is like that of a parent to a child. In the linear process, each snapshot has one parent and one child, except for the last snapshot, which has no children.

The snapshots taken form a tree. Each time you revert and take another, a branch (child) is formed.

In the process tree, each snapshot has one parent, but one snapshot may have more than one child. Many snapshots have no children.

You can revert to a parent or a child.

Snapshots and Other Activity in the Virtual Machine

When you take a snapshot, be aware of other activity going on in the virtual machine and the likely effect of reverting to that snapshot.

In general, it is best to take a snapshot when no applications in the virtual machine are communicating with other computers. The potential for problems is greatest if the virtual machine is communicating with another computer, especially in a production environment.

For example, if you take a snapshot while the virtual machine is downloading a file from a server on the network, the virtual machine continues downloading the file, communicating its progress to the server. If you revert to the snapshot, communications between the virtual machine and the server are confused and the file transfer fails.

Take a Snapshot

You can take a snapshot while a virtual machine is powered on, powered off, or suspended. If you are suspending a virtual machine, wait until the suspend operation has finished before taking a snapshot.

You must power off the virtual machine before taking a snapshot if the virtual machine has multiple disks in different disk modes. For example, if you have a special purpose configuration that requires you to use an independent disk, you must power off the virtual machine before taking a snapshot.

Procedure

1 Select **Inventory > Virtual Machine > Snapshot > Take Snapshot**.

You can also right-click the virtual machine and select **Snapshot > Take Snapshot**.

The Take Virtual Machine Snapshot window appears.

2 Type a name for your snapshot.

3 (Optional) Type a description for your snapshot.

4 (Optional) Select the **Snapshot the virtual machine's memory** check box if you want to capture the memory of the virtual machine.

5 (Optional) Select the **Quiesce guest file system (Needs VMware Tools installed)** check box to pause running processes on the guest operating system so that file system contents are in a known consistent state when the snapshot is taken. This applies only to virtual machines that are powered on.

6 Click **OK**.

When the snapshot has been successfully taken, it is listed in the **Recent Tasks** field at the bottom of the vSphere Client.

7 Click the target virtual machine to display tasks and events for this machine or, while the virtual machine is selected, click the **Tasks & Events** tab.

Change Disk Mode to Exclude Virtual Disks from Snapshots

Deleting a snapshot involves committing the existing data on the snapshot disk to the parent disk.

Prerequisites

You must power off and delete any existing snapshots before you attempt to change the disk mode.

Procedure

1 Select **Inventory > Virtual Machine > Edit Settings**.

2 Click the **Hardware** tab, and select the hard disk you want to exclude.

3 Under **Mode**, select Independent. Independent disks are not affected by snapshots.

You have the following persistence options for an independent disk:

Option	Description
Persistent	Disks in persistent mode behave like conventional disks on your physical computer. All data written to a disk in persistent mode are written permanently to the disk.
Nonpersistent	Changes to disks in nonpersistent mode are discarded when you power off or reset the virtual machine. Nonpersistent mode enables you to restart the virtual machine with a virtual disk in the same state every time. Changes to the disk are actually written to and read from a redo log file that is deleted when you power off or reset.

4 Click **OK**.

Using the Snapshot Manager

The Snapshot Manager lets you review all snapshots for the active virtual machine and act on them directly.

The Snapshot Manager window contains the following areas: Snapshot tree, Details region, Command buttons, Navigation region, and a You are here icon.

- Snapshot tree – Displays all snapshots for the virtual machine.
- You are here icon – Represents the current operational state of the virtual machine. The **You are here** icon is always selected and visible when you open the Snapshot Manager.

  You cannot go to or select the You are here state. You are here always represents the current and active state.
- Command Buttons – The Snapshot Manager has three command buttons in the left pane: Go to, Delete, and Delete All.
- Details – Displays the name and description of the selected snapshot. These fields are blank if you have not selected a snapshot.
- Navigation Region – Contains buttons for navigating out of the dialog box:
  - **Close** – Closes the Snapshot Manager.
  - **Help** – Opens the help system.

Restore a Snapshot

The **Go to** button allows you to restore the state of any snapshot.

Procedure

1 Select **Inventory > Virtual Machine > Snapshot > Snapshot Manager**.

2 In the Snapshot Manager, select a snapshot by clicking it.

3 Click the **Go to** button to restore the virtual machine to any arbitrary snapshot.

NOTE Virtual machines running certain kinds of workloads might take several minutes to resume responsiveness after reverting from a snapshot. This delay may be improved by increasing the guest memory.

4 Click **Yes** in the confirmation dialog box.

Delete a Snapshot

You can permanently remove a snapshot from vCenter Server.

Procedure

1 Select **Inventory > Virtual Machine > Snapshot > Snapshot Manager**.

2 In the Snapshot Manager, select a snapshot by clicking it.

3 Click **Delete** to permanently remove a snapshot from vCenter Server.

Clicking **Delete All**permanently removes all snapshots from the virtual machine.

NOTE **Delete** commits the snapshot data to the parent and removes the selected snapshot. **Delete All** commits all the immediate snapshots before the **You are here** current state to the base disk and removes all existing snapshots for that virtual machine. When using the **Delete All** option in Snapshot Manager, the snapshot farthest from the base disk is committed to its parent, causing that parent snapshot to grow. When that commit is complete, that snapshot is removed and the process starts over on the newly updated snapshot to its parent. This continues until every snapshot has been committed. This method can be relatively slow since data farthest from the base disk might be copied several times. More importantly, this method can aggressively use disk space if the snapshots are large, which is especially problematic if a limited amount of space is available on the datastore. The space issue is troublesome in that you might chose to delete snapshots explicitly to free up storage. This issue is resolved in ESX 4.0 Update 2 in that the order of snapshot consolidation has been modified to start with the snapshot closest to the base disk instead of farthest. The end result is that copying data repeatedly is avoided.

4 Click **Yes** in the confirmation dialog box.

Restore a Snapshot

To return a virtual machine to its original state, you can restore a snapshot.

Do one of the following:

Procedure

- The **Inventory > Virtual Machine > Snapshot** menu contains the command **Revert to Snapshot**.
- The Snapshot Manager has a **Go to** button.

Parent Snapshot

The parent snapshot is the most recently saved version of the current state of the virtual machine.

If you have just taken a snapshot, that stored state is the parent snapshot of the current state (You are here). If you revert or go to a snapshot, that snapshot becomes the parent of the current state (You are here).

The parent snapshot is always the snapshot appearing immediately above the You are here icon in the Snapshot Manager.

NOTE The parent snapshot is not always the snapshot you took most recently.

Revert to Snapshot Command

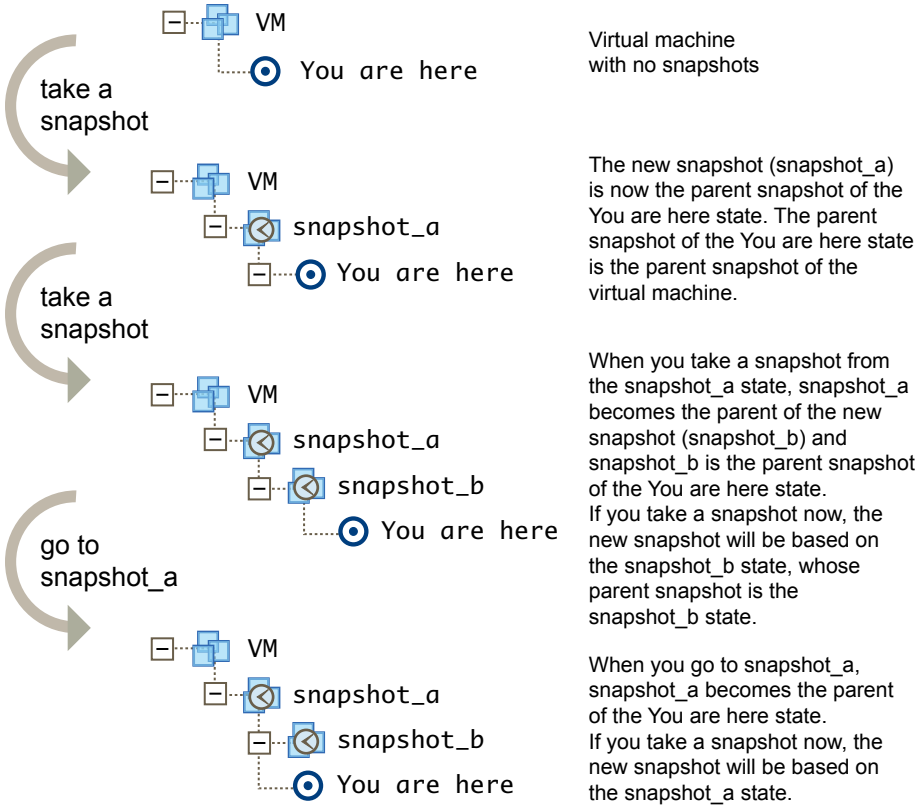
Reverting snapshots immediately activates the parent snapshot of the current state of the virtual machine.

The current disk and memory states are discarded and restored as they were when you took that snapshot. If your parent snapshot was taken when the virtual machine was powered off, choosing **Snapshot > Revert to Snapshot** moves the powered-on virtual machine to that parent state, that is, to a powered-off state.

If the snapshot was taken while the virtual machine was powered on and the virtual machine settings are set to revert to snapshot when powering off, the virtual machine moves to a suspended state when it reverts to the parent snapshot. If the no memory option is set, the virtual machine moves to a suspended state, even if the revert operation is performed, but not through the powered-off action. If the memory option is set, the power-off revert action puts the virtual machine in a suspended state. This process is illustrated in Figure 17-1.

NOTE Virtual machines running certain kinds of workloads might take several minutes to resume responsiveness after reverting from a snapshot. This delay may be improved by increasing the guest memory.

Figure 17-1. Revert to Snapshot


VM
You are here
take a snapshot
VM
snapshot_a
You are here
take a snapshot
VM
snapshot_a
snapshot_b
You are here
go to snapshot_a
VM
snapshot_a
snapshot_b
You are here
Virtual machine with no snapshots
The new snapshot (snapshot_a) is now the parent snapshot of the You are here state. The parent snapshot of the You are here state is the parent snapshot of the virtual machine.
When you take a snapshot from the snapshot_a state, snapshot_a becomes the parent of the new snapshot (snapshot_b) and snapshot_b is the parent snapshot of the You are here state. If you take a snapshot now, the new snapshot will be based on the snapshot_b state, whose parent snapshot is the snapshot_b state.
When you go to snapshot_a, snapshot_a becomes the parent of the You are here state. If you take a snapshot now, the new snapshot will be based on the snapshot_a state.

When you revert a virtual machine, the virtual machine returns to the parent snapshot of the virtual machine (that is, the parent of the current You are here state).

Revert to Snapshot is a shortcut to the parent snapshot of **You are here**

NOTE vApp metadata for virtual machines within vApps does not follow the snapshot semantics for virtual machine configuration. vApp properties that are deleted, modified, or defined after a snapshot is taken remain intact (deleted, modified, or defined) after the virtual machine reverts to that snapshot or any prior snapshots.

Revert to Parent Snapshot

You can revert any snapshot to the parent snapshot state.

Procedure

- Select **Inventory > Virtual Machine > Snapshot > Revert to Snapshot**.

System Administration

Managing Users, Groups, Roles, and Permissions

18

Use users, groups, roles, and permissions to control who has access to your vSphere managed objects and what actions they can perform.

vCenter Server and ESX/ESXi hosts determine the level of access for the user based on the permissions that are assigned to the user. The combination of user name, password, and permissions is the mechanism by which vCenter Server and ESX/ESXi hosts authenticate a user for access and authorize the user to perform activities. The servers and hosts maintain lists of authorized users and the permissions assigned to each user.

Privileges define basic individual rights that are required to perform actions and read properties. ESX/ESXi and vCenter Server use sets of privileges, or roles, to control which users or groups can access particular vSphere objects. ESX/ESXi and vCenter Server provide a set of pre-established roles. You can also create new roles.

The privileges and roles assigned on an ESX/ESXi host are separate from the privileges and roles assigned on a vCenter Server system. When you manage a host using vCenter Server, only the privileges and roles assigned through the vCenter Server system are available. If you connect directly to the host using the vSphere Client, only the privileges and roles assigned directly on the host are available.

This chapter includes the following topics:

- "Managing vSphere Users," on page 213
- "Groups," on page 214
- "Removing or Modifying Users and Groups," on page 215
- "Best Practices for Users and Groups," on page 215
- "Using Roles to Assign Privileges," on page 215
- "Permissions," on page 219
- "Best Practices for Roles and Permissions," on page 226
- "Required Privileges for Common Tasks," on page 227

Managing vSphere Users

A user is an individual authorized to log in to a host or vCenter Server.

Several users can access the vCenter Server system from different vSphere Client sessions at the same time. vSphere does not explicitly restrict users with the same authentication credentials from accessing and taking action within the vSphere environment simultaneously.

You manage users defined on the vCenter Server system and users defined on individual hosts separately. Even if the user lists of a host and a vCenter Server system appear to have common users (for instance, a user called devuser), these users should be treated as separate users who have the same name. The attributes of devuser in vCenter Server, including permissions, passwords, and so forth, are separate from the attributes of devuser on the ESX/ESXi host. If you log in to vCenter Server as devuser, you might have permission to view and delete files from a datastore. If you log in to an ESX/ESXi host as devuser, you might not have these permissions.

vCenter Server Users

Authorized users for vCenter Server are those included in the Windows domain list referenced by vCenter Server or local Windows users on the vCenter Server system. The permissions defined for these users apply whenever a user connects to vCenter Server.

You cannot use vCenter Server to manually create, remove, or otherwise change vCenter Server users. To manipulate the user list or change user passwords, use the tools you use to manage your Windows domain or Active Directory. For more information on creating users and groups for use with vCenter Server, see your Microsoft documentation.

Any changes you make to the Windows domain are reflected in vCenter Server. Because you cannot directly manage users in vCenter Server, the user interface does not provide a user list for you to review. You see these changes only when you select users to configure permissions.

vCenter Servers connected in a Linked Mode group use Active Directory to maintain the list of users, allowing all vCenter Server systems in the group to share a common set of users.

Host Users

Users authorized to work directly on an ESX/ESXi host are added to the internal user list by default when ESX/ESXi is installed or by a system administrator after installation.

If you log in to an ESX/ESXi host as root using the vSphere Client, you can use the **Users and Groups** tab to perform a variety of management activities for these users. You can add users, remove users, change passwords, set group membership, and configure permissions.

CAUTION See the Authentication and User Management chapter of the *ESX Configuration Guide* or *ESXi Configuration Guide* for information about root users and your ESX/ESXi host before you make any changes to the default users. Mistakes regarding root users can have serious access consequences.

Each ESX/ESXi host has two default users:

- The root user has full administrative privileges. Administrators use this log in and its associated password to log in to a host through the vSphere Client. Root users have a complete range of control activities on the specific host that they are logged on to, including manipulating permissions, creating groups and users (on ESX/ESXi hosts only), working with events, and so on.
- The vpxuser user is a vCenter Server entity with root rights on the ESX/ESXi host, allowing it to manage activities for that host. The vpxuser is created at the time that an ESX/ESXi host is attached to vCenter Server. It is not present on the ESX host unless the host is being managed through vCenter Server.

Groups

You can efficiently manage some user attributes by creating groups. A group is a set of users that you manage through a common set of permissions.

A user can be a member of more than one group. When you assign permissions to a group, all users in the group inherit those permissions. Using groups can significantly reduce the time it takes to set up your permissions model.

The group lists in vCenter Server and an ESX/ESXi host are drawn from the same sources as the user lists. If you are working through vCenter Server, the group list is called from the Windows domain. If you are logged on to an ESX/ESXi host directly, the group list is called from a table maintained by the host..

Create groups for the vCenter Server system through the Windows domain or Active Directory database. Create groups for ESX/ESXi hosts using the Users and Groups tab in the vSphere Client when connected directly to the host.

NOTE If you use Active Directory groups, make sure that they are security groups and not distribution groups. Permisions assigned to distribution groups are not enforced by vCenter Server. For more information on security groups and distribution groups, see the Microsoft Active Directory documentation.

Removing or Modifying Users and Groups

When you remove users or groups, you also remove permissions granted to those users or groups. Modifying a user or group name causes the original name to become invalid.

See the Security chapter in the *ESX Configuration Guide* or *ESXi Configuration Guide* for information about removing users and groups from an ESX/ESXi host.

To remove users or groups from vCenter Server, you must remove them from the domain or Active Directory users and groups list.

If you remove users from the vCenter Server domain, they lose permissions to all objects in the vSphere environment and cannot log in again. Users who are currently logged in and are removed from the domain retain their vSphere permissions only until the next validation period (the default is every 24 hours). Removing a group does not affect the permissions granted individually to the users in that group, or those granted as part of inclusion in another group.

If you change a user's name in the domain, the original user name becomes invalid in the vCenter Server system. If you change the name of a group, the original group becomes invalid only after you restart the vCenter Server system.

Best Practices for Users and Groups

Use best practices for managing users and groups to increase the security and manageability of your vSphere environment.

VMware recommends several best practices for creating users and groups in your vSphere environment:

- Use vCenter Server to centralize access control, rather than defining users and groups on individual hosts.
- Choose a local Windows user or group to have the Administrator role in vCenter Server.
- Create new groups for vCenter Server users. Avoid using Windows built-in groups or other existing groups.

Using Roles to Assign Privileges

A role is a predefined set of privileges. Privileges define basic individual rights required to perform actions and read properties.

When you assign a user or group permissions, you pair the user or group with a role and associate that pairing with an inventory object. A single user might have different roles for different objects in the inventory. For example, if you have two resource pools in your inventory, Pool A and Pool B, you might assign a particular user the Virtual Machine User role on Pool A and the Read Only role on Pool B. This would allow that user to power on virtual machines in Pool A, but not those in Pool B, although the user would still be able to view the status of the virtual machines in Pool B.

The roles created on an ESX/ESXi host are separate from the roles created on a vCenter Server system. When you manage a host using vCenter Server, only the roles created through vCenter Server are available. If you connect directly to the host using the vSphere Client, only the roles created directly on the host are available.

vCenter Server and ESX/ESXi hosts provide default roles:

System roles System roles are permanent. You cannot edit the privileges associated with these roles.

Sample roles VMware provides sample roles for convenience as guidelines and suggestions. You can modify or remove these roles.

You can also create completely new roles.

All roles permit the user to schedule tasks by default. Users can schedule only tasks they have permission to perform at the time the tasks are created.

NOTE Changes to permissions and roles take effect immediately, even if the users involved are logged in, except for searches, where permissions changes take effect after the user has logged out and logged back in again.

Default Roles for ESX/ESXi and vCenter Server

vCenter Server, ESX, and ESXi provide default roles. These roles group together privileges for common areas of responsibility in a vSphere environment.

You can use the default roles to assign permissions in your environment, or use them as a model to develop your own roles.

Table 18-1 lists the default roles for ESX/ESXi and vCenter Server.

Table 18-1. Default Roles

Role	Role Type	Description of User Capabilities
No Access	system	Cannot view or change the assigned object. vSphere Client tabs associated with an object appear without content. This role can be used to revoke permissions that would otherwise be propagated to an object from a parent object. This role is available in ESX/ESXi and vCenter Server.
Read Only	system	View the state and details about the object. View all the tab panels in the vSphere Client except the Console tab. Cannot perform any actions through the menus and toolbars. This role is available on ESX/ESXi and vCenter Server.
Administrator	system	All privileges for all objects. Add, remove, and set access rights and privileges for all the vCenter Server users and all the virtual objects in the vSphere environment. This role is available in ESX/ESXi and vCenter Server.
Virtual Machine Power User	sample	A set of privileges to allow the user to interact with and make hardware changes to virtual machines, as well as perform snapshot operations. Privileges granted include: ■ All privileges for the scheduled task privileges group. ■ Selected privileges for global items, datastore, and virtual machine privileges groups. ■ No privileges for folder, datacenter, network, host, resource, alarms, sessions, performance, and permissions privileges groups. Usually granted on a folder that contains virtual machines or on individual virtual machines. This role is available only on vCenter Server.

Table 18-1. Default Roles (Continued)

Role	Role Type	Description of User Capabilities
Virtual Machine User	sample	A set of privileges to allow the user to interact with a virtual machine's console, insert media, and perform power operations. Does not grant privileges to make virtual hardware changes to the virtual machine. Privileges granted include: ■ All privileges for the scheduled tasks privileges group. ■ Selected privileges for the global items and virtual machine privileges groups. ■ No privileges for the folder, datacenter, datastore, network, host, resource, alarms, sessions, performance, and permissions privileges groups. Usually granted on a folder that contains virtual machines or on individual virtual machines. This role is available only on vCenter Server.
Resource Pool Administrator	sample	A set of privileges to allow the user to create child resource pools and modify the configuration of the children, but not to modify the resource configuration of the pool or cluster on which the role was granted. Also allows the user to grant permissions to child resource pools, and assign virtual machines to the parent or child resource pools. Privileges granted include: ■ All privileges for folder, virtual machine, alarms, and scheduled task privileges groups. ■ Selected privileges for resource and permissions privileges groups. ■ No privileges for datacenter, network, host, sessions, or performance privileges groups. Additional privileges must be granted on virtual machines and datastores to allow provisioning of new virtual machines. Usually granted on a cluster or resource pool. This role is available only on vCenter Server.
VMware Consolidated Backup User	sample	This role is designed for use by the VMware Consolidated Backup product and should not be modified. This role is available only on vCenter Server.
Datastore Consumer	sample	A set of privileges to allow the user to consume space on the datastores on which this role is granted. To perform a space-consuming operation, such as creating a virtual disk or taking a snapshot, the user must also have the appropriate virtual machine privileges granted for these operations. Usually granted on a datastore or a folder of datastores. This role is available only on vCenter Server.
Network Consumer	sample	A set of privileges to allow the user to assign virtual machines or hosts to networks, provided that the appropriate permissions for the assignment are also granted on the virtual machines or hosts. Usually granted on a network or folder of networks. This role is available only on vCenter Server.

Create a Role

VMware recommends that you create roles to suit the access control needs of your environment.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

You must be logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 Right-click the **Roles** tab information panel and click **Add**.

3 Type a name for the new role.

4 Select privileges for the role and click **OK**.

Clone a Role

You can make a copy of an existing role, rename it, and later edit it. When you make a copy, the new role is not applied to the same users or groups and objects.

If you create or modify a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. However, assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

You must be logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 To select the role to duplicate, click the object in the list of **Roles**.

3 To clone the selected role, select **Administration > Role > Clone**.

A duplicate of the role is added to the list of roles. The name is `Copy of <rolename>`.

Edit a Role

When you edit a role, you can change any of the privileges selected for that role. When completed, these new privileges are applied to any user or group assigned the edited role.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. However, assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

You must be logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 To select the role to edit, click the object in the list of **Roles**.

3 Select **Administration > Role > Edit Role**.

4 Select privileges for the role and click **OK**.

Remove a Role

When you remove a role, if it is not assigned to any users or groups, the definition is removed from the list of possible roles. When you remove a role that is assigned to a user or group you can remove all assignments or replace them with an assignment to another role.

CAUTION Be sure that you understand how users will be affected before removing all assignments or replacing them. Users that have no permissions granted to them cannot log in to vCenter Server.

Prerequisites

You must be logged in as a user with Administrator privileges.

If you are removing a role from a vCenter Server system that is part of a connected group in Linked Mode, check the usage of that role on the other vCenter Server systems in the group before proceeding. Removing a role from one vCenter Server system also removes the role from all other vCenter Server systems in the group, even if you choose to reassign permissions to another role on the current vCenter Server system.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 To select the role to remove, click the object in the list of roles.

3 Select **Administration > Role > Remove**.

4 Click **OK**.

The role is removed from the list and is no longer available for assigning to users or groups.

If the role is assigned to a user or group, a warning message appears.

5 Select a reassignment option and click **OK**.

Option	Description
Remove Role Assignments	Removes any configured user or group and role pairings on the server. If a user or group does not have any other permissions assigned, they lose all privileges.
Reassign affected users to	Reassigns any configured user or group and role pairings to the selected new role.

Rename a Role

Renaming a role does not change that role's assignments.

If you create or modify a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. However, assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

You must be logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 To select the role to rename, click the object in the list of roles.

3 Select **Administration > Role > Rename**.

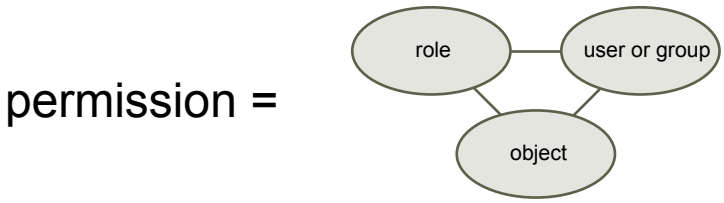
4 Type the new name.

Permissions

In vSphere, a permission consists of a user or group and an assigned role for an inventory object, such as a virtual machine or ESX/ESXi host. Permissions grant users the right to perform the activities specified by the role on the object to which the role is assigned.

For example, to configure memory for an ESX/ESXi host, a user must be granted a role that includes the **Host.Configuration.Memory Configuration** privilege. By assigning different roles to users or groups for different objects, you can precisely control the tasks that users can perform in your vSphere environment.

Figure 18-1. The Conceptual Structure of a Permission



By default, all users who are members of the Windows Administrators group on the vCenter Server system have the same access rights as any user assigned to the Administrator role on all objects. When connecting directly to an ESX/ESXi host, the root and vpxuser user accounts have the same access rights as any user assigned the Administrator role on all objects.

All other users initially have no permissions on any objects, which means they cannot view these objects or perform operations on them. A user with Administrator privileges must assign permissions to these users to allow them to perform necessary tasks.

Many tasks require permissions on more than one object. Some general rules can help you determine where you must assign permissions to allow particular operations:

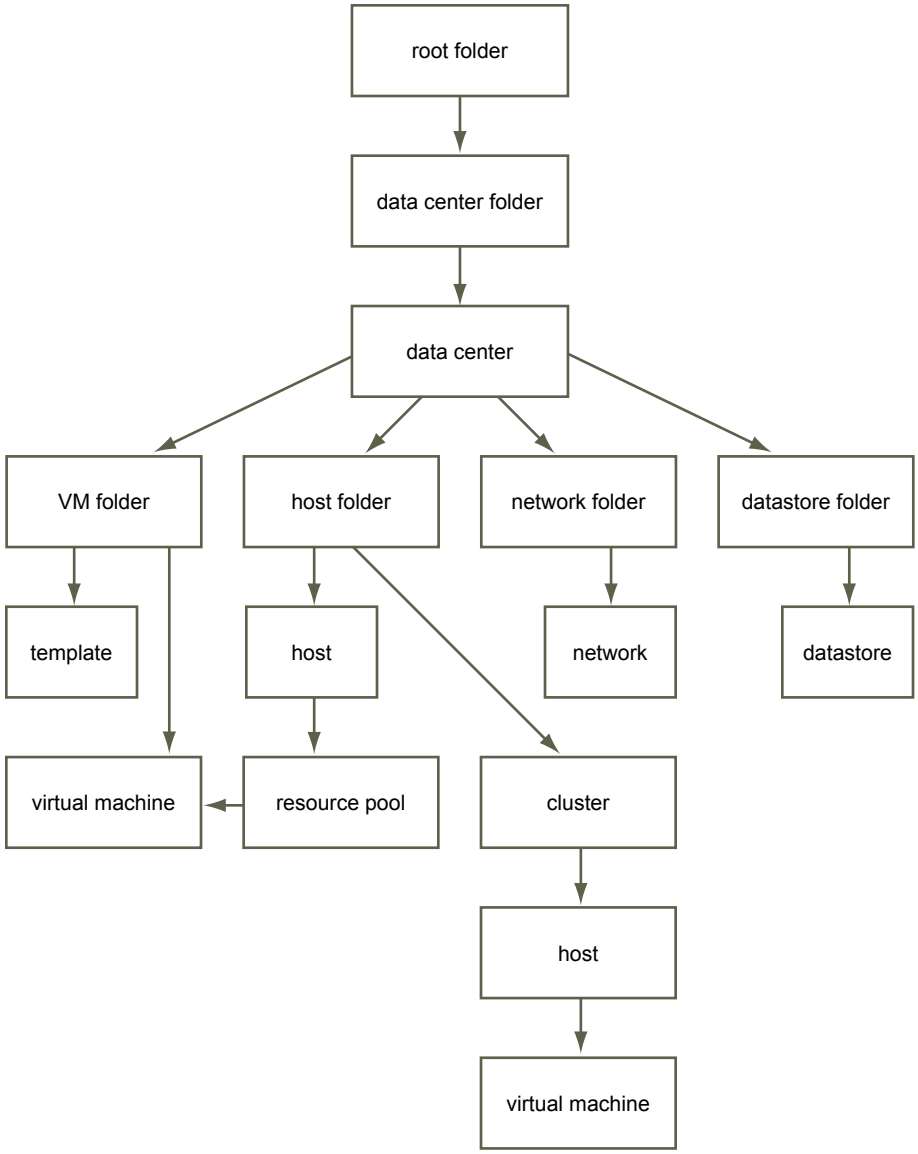
- Any operation that consumes storage space, such as creating a virtual disk or taking a snapshot, requires the **Datastore.Allocate Space** privilege on the target datastore, as well as the privilege to perform the operation itself.
- Moving an object in the inventory hierarchy requires appropriate privileges on the object itself, the source parent object (such as a folder or cluster), and the destination parent object.
- Each host and cluster has its own implicit resource pool that contains all the resources of that host or cluster. Deploying a virtual machine directly to a host or cluster requires the **Resource.Assign Virtual Machine to Resource Pool** privilege.

Hierarchical Inheritance of Permissions

When you assign a permission to an object, you can choose whether the permission propagates down the object hierarchy. Propagation is set per permission, not universally applied. Permissions defined for a child object always override those propagated from parent objects.

Figure 18-2 illustrates the vSphere inventory hierarchy, and the paths by which permissions can propagate.

Figure 18-2. vSphere Inventory Hierarchy



Most inventory objects inherit permissions from a single parent object in the hierarchy. For example, a datastore inherits permissions from either its parent datastore folder or parent datacenter. However, virtual machines inherit permissions from both the parent virtual machine folder and the parent host, cluster, or resource pool simultaneously. This means that to restrict a user's privileges on a virtual machine, you must set permissions on both the parent folder and the parent host, cluster or resource pool for that virtual machine.

You cannot set permissions directly on a vNetwork Distributed Switches. To set permissions for a vNetwork Distributed Switch and its associated dvPort Groups, set permissions on a parent object, such a folder or datacenter, and select the option to propagate these permissions to child objects.

Permissions take several forms in the hierarchy:

Managed entities Can have permissions defined on them.

- Clusters
- Datacenters
- Datastores
- Folders

- Hosts
- Networks (except vNetwork Distributed Switches)
- dvPort Groups
- Resource pools
- Templates
- Virtual machines
- vApps

Global entities

Derive their permissions from the root vCenter Server system.

- Custom fields
- Licenses
- Roles
- Statistics intervals
- Sessions

Multiple Permission Settings

Objects might have multiple permissions, but at most one for each user or group.

Permissions applied on a child object always override permissions applied on a parent object. Virtual machine folders and resource pools are equivalent levels in the hierarchy. If a user or group is assigned propagating permissions on both a virtual machine's folder and its resource pool, the user has the privileges propagated from the resource pool and from the folder.

If multiple group permissions are defined on the same object and the user belongs to two or more of those groups, two situations are possible:

- If no permission is defined for the user on that object, the user is assigned the union of privileges assigned to the groups for that object.
- If a permission is defined for the user on that object, the user's permission takes precedence over all group permissions.

Example 1: Inheritance of Multiple Permissions

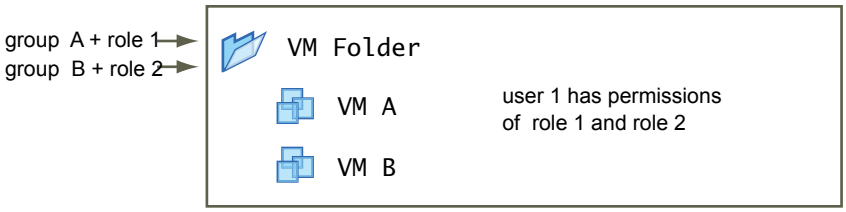
This example illustrates how an object can inherit multiple permissions from groups granted permission on a parent object.

In this example, two permissions are assigned on the same object for two different groups.

- Role 1 can power on virtual machines.
- Role 2 can take snapshots of virtual machines.
- Group A is granted Role 1 on VM Folder, with the permission set to propagate to child objects.
- Group B is granted Role 2 on VM Folder, with the permission set to propagate to child objects.
- User 1 is not assigned specific permission.

User 1, who belongs to groups A and B, logs on. User 1 can both power on and take snapshots of VM A and VM B.

Figure 18-3. Example 1: Inheritance of Multiple Permissions



Example 2: Child Permissions Overriding Parent Permissions

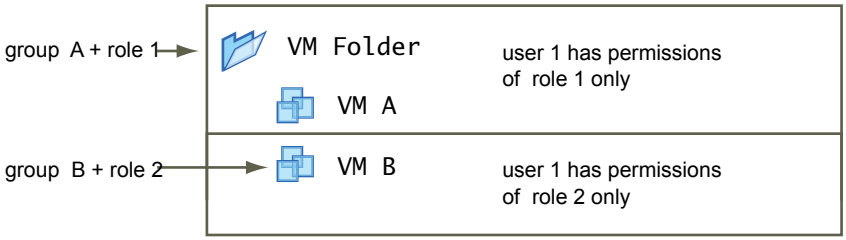
This example illustrates how permissions assigned on a child object override permissions assigned on a parent object. You can use this overriding behavior to restrict user access to particular areas of the inventory.

In this example, permissions are to two different groups on two different objects.

- Role 1 can power on virtual machines.
- Role 2 can take snapshots of virtual machines.
- Group A is granted Role 1 on VM Folder, with the permission set to propagate to child objects.
- Group B is granted Role 2 on VM B.

User 1, who belongs to groups A and B, logs on. Because Role 2 has been assigned at a lower point in the hierarchy than Role 1, it overrides Role 1 on VM B. User 1 can power on VM A, but not take snapshots. User 1 can take snapshots of VM B, but not power it on.

Figure 18-4. Example 2: Child Permissions Overriding Parent Permissions



Example 3: User Permissions Overriding Group Permissions

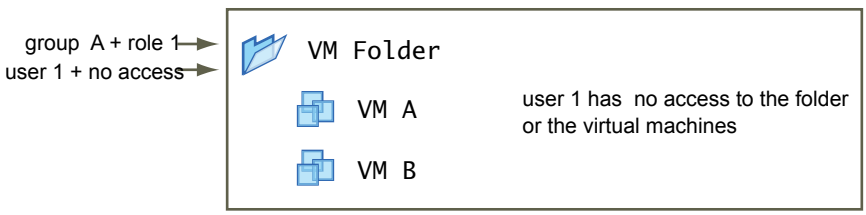
This example illustrates how permissions assigned directly to an individual user override permissions assigned to a group that the user is a member of.

In this example, permissions are assigned to a user and to a group on the same object.

- Role 1 can power on virtual machines.
- Group A is granted Role 1 on VM Folder.
- User 1 is granted No Access role on VM Folder.

User 1, who belongs to group A, logs on. The No Access role granted to User 1 on VM Folder overrides the group permission. User 1 has no access to VM Folder or VMs A and B.

Figure 18-5. Example 3: User Permissions Overriding Group Permissions



Permission Validation

vCenter Server regularly validates its users and groups against the Windows Active Directory domain. Validation occurs whenever the vCenter Server system starts and at regular intervals specified in the vCenter Server settings.

For example, if user Smith was assigned permissions and in the domain the user's name was changed to Smith2, vCenter Server concludes that Smith no longer exists and removes permissions for that user when the next validation occurs.

Similarly, if user Smith is removed from the domain, all permissions are removed when the next validation occurs. If a new user Smith is added to the domain before the next validation occurs, the new user Smith receives all the permissions the old user Smith was assigned.

Assign Permissions

After you create users and groups and define roles, you must assign the users and groups and their roles to the relevant inventory objects. You can assign the same permissions at one time on multiple objects by moving the objects to a folder and setting the permissions on the folder.

Prerequisites

Required privilege: **Permissions.Modify permission** on the parent object of the object whose permissions you want to modify.

Procedure

1 Select an object and click the **Permissions** tab.

2 Right-click the **Permissions** tab and select **Add Permission**.

3 Select a role from the **Assigned Role** drop-down menu.

This menu displays all the roles that are assigned to the object. When the role appears, the privileges contained in the role are listed in the section below the role title for reference purposes.

4 (Optional) Deselect the **Propagate to Child Objects** check box.

If you deselect this check box, the role is applied only to the selected object, and does not propagate to the child objects.

5 Click **Add** to open the Select Users or Groups dialog box.

6 Identify the user or group to assign to this role.

a Select the domain where the user or group is located from the **Domain** drop-down menu.

b Type a name in the Search box or select a name from the **Name** list.

c Click **Add**.

The name is added to either the **Users** or **Groups** list.

d Repeat Step 6a through Step 6c to add additional users or groups.

e Click **OK** when finished.

7 Verify the users and groups are assigned to the appropriate permissions, and click **OK**.

8 To finish the task, click **OK**.

The server adds the permission to the list of permissions for the object.

The list of permissions references all users and groups that have roles assigned to the object, and indicates where in the vCenter Server hierarchy the role is assigned.

Adjust the Search List in Large Domains

If you have domains with thousands of users or groups, or if searches take a long time to complete, adjust the search settings for use in the Select Users or Groups dialog box.

NOTE This procedure applies only to vCenter Server user lists. ESX/ESXi user lists cannot be searched in the same way.

Procedure

1 From the vSphere Client connected to a vCenter Server system, select **Administration > vCenter Server Management Server Configuration**.

2 Click the **Active Directory** list item.

3 Change the values as needed.

Option	Description
Active Directory Timeout	Specifies in seconds the maximum amount of time vCenter Server allows the search to run on the selected domain. Searching very large domains can take a very long time.
Enable Query Limit	To specify no maximum limit on the number of users and groups that vCenter Server displays from the selected domain, deselect the check box.
Users & Groups value	Specifies the maximum number of users and groups vCenter Server displays from the selected domain in the Select Users or Groups dialog box.

4 Click **OK**.

Change Permission Validation Settings

vCenter Server periodically validates its user and group lists against the users and groups in the Windows Active Directory domain, and removes users or groups that no longer exist in the domain. You can change the interval between validations.

Procedure

1 From the vSphere Client connected to a vCenter Server system, select **Administration > vCenter Server Management Server Configuration**.

2 Click the **Active Directory** list item.

3 Deselect the **Enable Validation** check box to disable validation.

Validation is enabled by default. Users and groups are always validated when vCenter Server system starts, even if validation is disabled.

4 If validation is enabled, enter a value in the **Validation Period** text box to specify a time, in minutes, between validations.

Change Permissions

After a user or group and role pair is set for an inventory object, you can change the role paired with the user or group or change the setting of the **Propagate** check box. You can also remove the permission setting.

Procedure

1 From the vSphere Client, select an object in the inventory.

2 Click the **Permissions** tab.

3 Click the line item to select the user or group and role pair.

4 Select **Inventory > Permissions > Properties**.

5 In the Change Access Role dialog box, select a role for the user or group from the drop-down menu.

6 To propagate the privileges to the children of the assigned inventory object, click the **Propagate** check box and click **OK**.

Remove Permissions

Removing a permission for a user or group does not remove the user or group from the list of those available. It also does not remove the role from the list of available items. It removes the user or group and role pair from the selected inventory object.

Procedure

1 From the vSphere Client, click the **Inventory** button in the navigation bar.

2 Expand the inventory as needed and click the appropriate object.

3 Click the **Permissions** tab.

4 Click the appropriate line item to select the user or group and role pair.

5 Select **Inventory > Permissions > Delete**.

vCenter Server removes the permission setting.

Best Practices for Roles and Permissions

Use best practices for roles and permissions to maximize the security and manageability of your vCenter Server environment.

VMware recommends the following best practices when configuring roles and permissions in your vCenter Server environment:

- Where possible, grant permissions to groups rather than individual users.
- Grant permissions only where needed. Using the minimum number of permissions makes it easier to understand and manage your permissions structure.
- If you assign a restrictive role to a group, check that the group does not contain the Administrator user or other users with administrative privileges. Otherwise, you could unintentionally restrict administrators' privileges in parts of the inventory hierarchy where you have assigned that group the restrictive role.
- Use folders to group objects to correspond to the differing permissions you want to grant for them.
- Use caution when granting a permission at the root vCenter Server level. Users with permissions at the root level have access to global data on vCenter Server, such as roles, custom attributes, vCenter Server settings, and licenses. Changes to licenses and roles propagate to all vCenter Server systems in a Linked Mode group, even if the user does not have permissions on all of the vCenter Server systems in the group.
- In most cases, enable propagation on permissions. This ensures that when new objects are inserted in to the inventory hierarchy, they inherit permissions and are accessible to users.
- Use the No Access role to masks specific areas of the hierarchy that you don’t want particular users to have access to.

Required Privileges for Common Tasks

Many tasks require permissions on more than one object in the inventory.

Table 18-2 lists common tasks that require more than one privilege. It lists the privileges required to perform the tasks and, where applicable, the appropriate sample roles. You can use the listed Applicable Roles on the listed inventory objects to grant permission to perform these tasks, or you can create your own roles with the equivalent required privileges.

Table 18-2. Required Privileges for Common Tasks

Task	Required Privileges	Applicable Role
Create a virtual machine	On the destination folder or datacenter: ■ **Virtual Machine.Inventory.Create** ■ **Virtual Machine.Configuration.Add New Disk** (if creating a new virtual disk) ■ **Virtual Machine .Configuration.Add Existing Disk** (if using an existing virtual disk) ■ **Virtual Machine.Configuration.Raw Device** (if using a RDM or SCSI pass-through device)	Virtual Machine Administrator
	On the destination host, cluster, or resource pool: **Resource.Assign Virtual Machine to Resource Pool**	Virtual Machine Administrator
	On the destination datastore or folder containing a datastore: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
	On the network that the virtual machine will be assigned to: **Network.Assign Network**	Network Consumer or Virtual Machine Administrator
Deploy a virtual machine from a template	On the destination folder or datacenter: ■ **Virtual Machine.Inventory.Create** ■ **Virtual Machine.Configuration.Add New Disk**	Virtual Machine Administrator
	On a template or folder of templates: **Virtual Machine.Provisioning.Deploy Template**	Virtual Machine Administrator
	On the destination host, cluster or resource pool: **Resource.Assign Virtual.Machine to Resource Pool**	Virtual Machine Administrator
	On the destination datastore or folder of datastores: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
	On the network that the virtual machine will be assigned to: **Network.Assign Network**	Network Consumer or Virtual Machine Administrator
Take a virtual machine snapshot	On the virtual machine or a folder of virtual machines: **Virtual Machine.State.Create Snapshot**	Virtual Machine Power User or Virtual Machine Administrator
	On the destination datastore or folder of datastores: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Move a virtual machine into a resource pool	On the virtual machine or folder of virtual machines: ■ **Resource.Assign Virtual Machine to Resource Pool** ■ **Virtual Machine.Inventory.Move**	Virtual Machine Administrator
	On the destination resource pool: **Resource.Assign Virtual Machine to Resource Pool**	Virtual Machine Administrator

Table 18-2. Required Privileges for Common Tasks (Continued)

Task	Required Privileges	Applicable Role
Install a guest operating system on a virtual machine	On the virtual machine or folder of virtual machines: ■ **Virtual Machine.Interaction.Answer Question** ■ **Virtual Machine.Interaction.Console Interaction** ■ **Virtual Machine.Interaction.Device Connection** ■ **Virtual Machine.Interaction.Power Off** ■ **Virtual Machine.Interaction.Power On** ■ **Virtual Machine.Interaction.Reset** ■ **Virtual Machine.Interaction.Configure CD Media** (if installing from a CD) ■ **Virtual Machine.Interaction.Configure Floppy Media** (if installing from a floppy disk) ■ **Virtual Machine.Interaction.Tools Install**	Virtual Machine Power User or Virtual Machine Administrator
	On a datastore containing the installation media ISO image: **Datastore.Browse Datastore** (if installing from an ISO image on a datastore)	Virtual Machine Power User or Virtual Machine Administrator
Migrate a virtual machine with VMotion	On the virtual machine or folder of virtual machines: ■ **Resource.Migrate** ■ **Resource.Assign Virtual Machine to Resource Pool** (if destination is a different resource pool from the source)	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination host, cluster, or resource pool (if different from the source): **Resource.Assign Virtual Machine to Resource Pool**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
Cold migrate (relocate) a virtual machine	On the virtual machine or folder of virtual machines: ■ **Resource.Relocate** ■ **Resource.Assign Virtual Machine to Resource Pool** (if destination is a different resource pool from the source)	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination host, cluster, or resource pool (if different from the source): **Resource.Assign Virtual Machine to Resource Pool**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination datastore (if different from the source): **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Migrate a Virtual Machine with Storage VMotion	On the virtual machine or folder of virtual machines: **Resource.Migrate**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination datastore: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Move a host into a cluster	On the host: **Host.Inventory.Add Host to Cluster**	Datacenter Administrator or Virtual Machine Administrator
	On the destination cluster: **Host.Inventory.Add Host to Cluster**	Datacenter Administrator or Virtual Machine Administrator

Monitoring Storage Resources 19

If you use vCenter Server to manage your ESX/ESXi hosts, you can review information on storage usage and visually map relationships between all storage entities available in vCenter Server.

In the vSphere Client, for any inventory object except networking, the storage usage data appears in the **Storage Views** tab. To view this tab, you must have the vCenter Storage Monitoring plug-in, which is generally installed and enabled by default.

You can display storage information as reports or storage topology maps.

Reports — Reports display relationship tables that provide insight about how an inventory object is associated with storage entities. They also offer summarized storage usage data for the object's virtual and physical storage resources. Use the **Reports** view to analyze storage space utilization and availability, multipathing status, and other storage properties of the selected object and items related to it.

Maps — Maps display storage topology maps that visually represent relationships between the selected object and its associated virtual and physical storage entities.

For more information on virtual and phisical storage resources and how virtual mahcines access sotrage, see *ESX Configuration Guide* or *ESXi Configuration Guide*.

This chapter includes the following topics:

- "Working with Storage Reports," on page 229
- "Working with Storage Maps," on page 231

Working with Storage Reports

Reports help you monitor storage information.

You can display and review statistics for different categories depending on the inventory object. For example, if the inventory object is a datastore, you can display information for all virtual machines that reside on the datastore, all hosts that have access to the datastore, the LUNs on which the datastore is deployed, and so on.

When you display the report tables, the default column headings depend on the inventory object you select. You can customize the tables by adding or removing columns. Reports are updated every 30 minutes. You can manually update the reports by clicking **Update**.

You can search for specific information you need to see by filtering report tables based on storage attributes and keywords.

Display Storage Reports

You display storage reports to review storage information for any inventory object except networking. For example, if the inventory object is a virtual machine, you can review all datastores and LUNs that the virtual machine uses, status of all paths to the LUNs, adapters that the host uses to access the LUNs, and so on.

Procedure

1 Display the object, for which you want to view reports, in the inventory.

For example, display virtual machines if you want to review storage information for a specific virtual machine.

2 Select the object and click **Storage Views > Reports**.

3 To display information for a specific category, click **Show all [Category of Items]** and select the appropriate category from the list.

For example, if you want to see all datastores that the virtual machine is using, select **Show all Datastores**.

4 To see the description of each column, move the cursor over the column heading.

Export Storage Reports

You can export storage usage data for an object in various formats, including XML, HTML, or Microsoft Excel.

Perform the following task in the vSphere Client.

Procedure

1 Display the object in the inventory.

2 Select the object and click **Storage Views > Reports**.

3 To display information for a specific category, click **Show all [Category of Items]**and select the appropriate category from the list.

4 Right-click below the table and select **Export List**.

5 Specify a file name, type, and location.

6 Click **Save**.

Filter Storage Reports

To search for specific information, you can filter reports based on any number of storage attributes you select and keywords you enter in the search field.

Procedure

1 In the inventory, display the object for which to filter the reports.

2 Select the object and click **Storage Views > Reports**.

3 To display information for a specific category, click **Show all [Category of Items]**and select the appropriate category from the list.

4 Click the search field arrow and select the attributes to include in the search.

5 Type a keyword into the box and press **Enter**.

The table is updated based on your search criteria. For example, if you are reviewing reports for datastores in a datacenter, you can display information for only those datastores that have NFS format by selecting the **File System Type** attribute and entering NFS as a key word. Filtering is persistent for the user session.

Customize Storage Reports

You display storage reports in the vSphere Client. When you display the reports tables, the default column headings depend on the inventory object you select. You can customize the tables by adding or removing columns.

Procedure

1 Display the object in the inventory for which you want to customize reports.

2 Select the object and click **Storage Views > Reports**.

3 To display information for a specific category, click **Show all [Category of Items]**and select the appropriate category from the list.

4 To add a column, right-click any column heading and select an item to display from the list.

5 To hide a column, right-click the column heading and deselect it in the list.

Working with Storage Maps

Storage maps help you visually represent and understand the relationships between an inventory object and all virtual and physical storage resources available for this object. Map views are object-centric and display only items relevant to the specific object.

Map views are updated every 30 minutes. You can manually update the maps by clicking the **Update** link.

You can customize a map view by selecting or deselecting options in the Show area, or by hiding specific items or changing their position on the map.

You can reposition the map by dragging it, and zoom in or out of the map or its particular section.

Display Storage Maps

For any inventory object except networking, you can display storage maps that graphically represent the relationships between the object, for example, a virtual machine, and all resources, such as datastores, LUNs, hosts, and so on, available for this object.

Procedure

1 Display the object in the inventory.

2 Select the object and click **Storage Views > Maps**.

Export Storage Maps

You can export maps to various graphic files, including JPEG, TIFF, and GIF.

Procedure

1 Display a storage map.

2 Right-click the map and select **Export Map** from the menu.

3 Type a file name, type, and location.

4 Click **Save**.

The image file is saved to the format and directory you specified.

Hide Items on Storage Maps

You can hide any number of items in a storage map.

Procedure

1 Display a storage map.

2 Right-click the item you want to hide and select **Hide Node** from the menu.

Move Items on Storage Maps

You might need to move individual items on the storage map to make the map visually more clear.

Procedure

1 Display a storage map.

2 Click the item you want to move and drag it to the new location.

Using vCenter Maps 20

A vCenter map is a visual representation of your vCenter Server topology. Maps show the relationships between the virtual and physical resources available to vCenter Server.

Maps are available only when the vSphere Client is connected to a vCenter Server system.

The maps can help you determine such things as which clusters or hosts are most densely populated, which networks are most critical, and which storage devices are being utilized. vCenter Server provides the following map views.

Virtual Machine Resources	Displays virtual machine-centric relationships.
Host Resources	Displays host-centric relationships.
Datastore Resources	Displays datastore-centric relationships.
VMotion Resources	Displays hosts available for VMotion migration.

You can use a map view to limit or expand the scope of a map. You can customize all map views, except VMotion Resources maps. If you are accessing map views using the navigation bar, all vCenter Server resources are available for display. If you are using the **Maps** tab of a selected inventory item, only items related to that item are displayed. For virtual machine inventory items, the VMotion Resources view is the only map view available on the **Maps** tab.

You can customize a map view by selecting or deselecting objects in the inventory pane or by selecting or deselecting options in the **Map Relationships** area.

You can reposition the map by dragging it (click and hold anywhere on the map and drag the map to the new location). A grey box in the overview area represents the section of the total map that is viewable and moves as you drag the map. You can resize the grey box to zoom in or out of a section of the map.

You can double-click any object in a map to switch to the **Map** tab for that item (providing a **Map** tab is available for that type of object).

Right-click on any object in a map to access its context menu.

This chapter includes the following topics:

- "vCenter VMotion Maps," on page 234
- "vCenter Map Icons and Interface Controls," on page 234
- "View vCenter Maps," on page 235
- "Print vCenter Maps," on page 235
- "Export vCenter Maps," on page 235

vCenter VMotion Maps

VMotion resource maps provide a visual representation of hosts, datastores, and networks associated with the selected virtual machine.

VMotion resource maps also indicate which hosts in the virtual machine's cluster or datacenter are compatible with the virtual machine and are potential migration targets. For a host to be compatible, it must meet the following criteria.

- Connect to all the same datastores as the virtual machine.
- Connect to all the same networks as the virtual machine.
- Have compatible software with the virtual machine.
- Have a compatible CPU with the virtual machine.

NOTE The VMotion map provides information as to whether VMotion might be possible, and if not, what an administrator might do to remedy the situation. It does not guarantee that a particular VMotion migration will be successful.

vCenter Map Icons and Interface Controls

Resource maps are visual representations of your datacenter topology. Each icon in a resource map represents a managed object or its current state. Controls in the **Maps** tab enable you to work with the current resource map.

Map Icons

The icons in a resource map represent the objects in the inventory and their current state. Table 20-1 describes the map icons.

Table 20-1. Resource Map Icons

Icon	Description
	Host icon.
	A host that is compatible for VMotion migration. The color of the circle varies in intensity based on the load of the current host. Heavily used hosts are pale; low-load hosts are saturated green.
	A host that is not compatible for VMotion migration.
	Virtual machine icon. When the virtual machine is powered on, the icon contains a green triangle.
	Network icon.
	Datastore icon.

Map Interface Controls

Use the controls in the Maps tab to customize map relationships, refresh map views, and move the focus of the current map. Table 20-2 describes the controls located on the **Maps** tab.

Table 20-2. Resource Map Interface Controls

Map Interface Panel	Description
Overview panel	Thumbnail graphic of the full-scale map.
Map Relationships panel	Displayed when more than one map view is available. The Map Relationships panel lets you customize map relationships for hosts and virtual machines. Use the checkboxes to enable or disable relationships for the selected object and display them in the current resource map.
Refresh link	Maps do not auto-refresh. Click **Refresh** to synchronize your map with the current state of the inventory and to center the map view.
Inventory panel	When selecting through the Inventory navigation bar, a selected item stays highlighted to indicate map focus. When selecting through the Maps navigation bar, all items in the inventory are listed with a check box. You can select or deselect any inventory items you do not want included in the map.

View vCenter Maps

Resource maps enable you to view the relationships among hosts, clusters, and virtual machines. You can view a resource map for an entire vCenter Server system or for a specific object, such as a datacenter or cluster. Maps for specific objects show only the object relationships for that object.

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Maps** tab.

For example, to display the resource map for your entire vCenter Server system, select the vCenter Server in the inventory panel. To display the resource map for a host, select the host in the inventory panel.

Print vCenter Maps

You can print resource maps to any standard printer.

Perform this procedure on the vSphere Client **Map** tab.

Procedure

1 Select **File > Print Maps > Print**.

2 In the printer **Name** list, select the printer.

3 Click **Print**.

Export vCenter Maps

Exporting a resource map saves the map to an image file.

Perform this procedure on the vSphere Client **Map** tab.

Procedure

1 If necessary, view the resource map.

2 Select **File > Export > Export Maps**.

3 Navigate to the location to save the file.

4 Type a name for the file and select a file format.

5 Click **Export**.

Working with Alarms 21

Alarms are notifications that occur in response to selected events, conditions, and states that occur with objects in the inventory. You use the vSphere Client to create and modify alarms.

The vCenter Server system is configured with a set of predefined alarms that monitor clusters, hosts, datacenters, datastores, networks, and virtual machines. it is also configured with alarms that monitor vCenter Server licensing.

Each predefined alarm monitors a specific object and applies to all objects of that type. For example, by default, the Host CPU Usage alarm is set automatically on each host in the inventory and triggers automatically when any host's CPU usage reaches the defined CPU value.

If the predefined vCenter Server alarms do not account for the condition, state, or event you need to monitor, you can define custom alarms.

When you set an alarm on a parent object, such as a vCenter Server, a datatcenter, or a cluster, all applicable child objects inherit the alarm. You can also set an alarm on a folder to propagate the same alarm to all objects contained in that folder. You cannot change or override an alarm that is set on a child object from its parent object. You must change the alarm on the child object itself.

Alarms are composed of a trigger and an action.

Trigger

A set of conditions that must be met for an alarm warning and alert to occur. Most triggers consist of a condition value and a length of time that value is true. For example, the virtual machine memory alarm triggers a warning when memory usage is over 75% for one hour and over 90% for five minutes.

VMware uses colors to denote alarm severity:

- Normal – green
- Warning – yellow
- Alert – red

You can set alarms to trigger when the state changes from green to yellow, yellow to red, red to yellow, and yellow to green. Triggers are defined for the default VMware alarms. You can change the trigger conditions (thresholds, warning values, and alert values) for the default alarms.

Action The operation that occurs in response to the trigger. For example, you can have an email notification sent to one or more administrators when an alarm is triggered. The default vCenter Server alarms are not preconfigured with actions. You must manually set what action occurs when the triggering event, condition, or state occurs.

NOTE Some alarms contain triggers that are not supported in the vSphere Client and cannot be changed. However, you can still configure the alarm actions, enable or disable the alarm, and change the alarm name. If your environment requires changes to these alarm triggers, create custom alarms by using the vSphere Client or the VMware vSphere APIs.

This chapter includes the following topics:

- "Alarm Triggers," on page 238
- "Alarm Actions," on page 248
- "Alarm Reporting," on page 253
- "Creating Alarms," on page 253
- "Managing Alarms," on page 257
- "Managing Alarm Actions," on page 261
- "Managing Alarm Actions," on page 261
- "Preconfigured VMware Alarms," on page 264

Alarm Triggers

You configure alarm triggers to generate warnings and alerts when the specified criteria is met. Alarms have two types of triggers: condition or state triggers, and event triggers.

Condition or State Triggers Monitor the current condition or state of virtual machines, hosts, and datastores. This includes power states, connection states, and performance metrics, such as CPU and disk usage. To set alarms on other objects in the inventory, including datacenters, clusters, resource pools, and networking objects, use event triggers.

NOTE You can set a condition or state alarm at the datacenter level that monitors all virtual machines, hosts, or datastores in the datacenter.

Event Triggers Monitors events that occur in response to operations occuring with any managed object in the inventory, the vCenter Server system, or the license server. For example, an event is recorded each time a virtual machine is cloned, created, deleted, deployed, and migrated.

Condition and State Triggers

Use condition triggers and state triggers to set alarms on performance metrics, power states, and connection states for virtual machines, hosts, and datastores. To set alarms on other objects in the inventory, you must use event triggers.

Condition and state triggers use one of the following operator sets to monitor an object:

- **Is equal to** and **Is not equal to**
- **Is above** and **Is below**

To define a condition or state trigger, you choose the appropriate operator set and enter the values for the warning and alert status. You can use any number of triggers for an alarm. When you use more than one trigger, you choose whether to trigger the alarm when any conditions are satisfied or when all conditions are satisfied. For example, you can create a host alarm that has two condition triggers, one for CPU usage and one for memory usage:

Table 21-1. Example – Setting Condition Triggers

		Warning		Alert	
Trigger	**Condition**	**Operator**	**Value**	**Operator**	**Value**
1	CPU usage	Is above	75%	Is above	90%
2	Memory usage	Is above	75%	Is above	90%

If you trigger the alarm when all conditions are satisfied, the alarm will trigger the warning only when both CPU usage and memory usage values are above 75%. Likewise, it will trigger the alert only when both CPU usage and memory usage are above 90%.

NOTE Unexpected results might occur when you have an alarm with multiple triggers with opposing warning and alert conditions, and you set the alarm to trigger when all conditions are satisfied. For example, an alarm has two triggers that set warnings and alerts for the virtual machine power state.

Table 21-2. Example – Opposing Warning and Alert Conditions

Trigger	**Warning**	**Alert**
1	Powered Off	Powered On
2	Powered On	Powered Off

If you choose to trigger the alarm when all conditions are satisfied, the alarm triggers a warning. This is because the vServer System uses the AndAlarmExpression operator to validate the condition statuses for each trigger. When they are all satisfied, the first condition is satisfied, and therefore is used: Warning & Alert = warning.

Condition and State Trigger Components

Condition and State triggers are comprised of a trigger type, a triggering condition and length, and warning and alert values.

Table 21-3 describes each component of Condition and State triggers.

Table 21-3. Condition and State Trigger Components

Trigger Component	**Description**
Trigger type	The condition or state to monitor, for example, **VM CPU Usage (%)**.
Condition	The qualifier used to set the threshold for the trigger, for example, **Is Above** and **Is Below**.

Table 21-3. Condition and State Trigger Components (Continued)

Trigger Component	Description
Warning	The value that must be reached for the alarm to transition from a normal state to a warning state, and to trigger the alarm.
Condition Length	For condition triggers, after the warning condition is reached, the amount of time the warning condition stays true in order for the warning to trigger. State triggers do not have condition lengths. As soon as the state condition occurs, the warning is triggered.
Alert	The value that must be reached for the alarm to transition from the warning state to an alert state and to trigger the alarm.
Condition Length	For condition triggers, after the alert value is reached, the amount of time the alert condition stays true in order for the alarm to trigger. State triggers do not have condition lengths. As soon as the state condition occurs, the alert is triggered.

For condition triggers to generate a warning or an alert, the value you set must be reached and for the specified condition length. For example, you can configure a condition trigger to generate a warning and an alert under the following conditions:

- A virtual machine's CPU usage must be above 75% for more than 10 minutes to generate a warning.
- A virtual machine's CPU usage must be above 95% for more than 5 minutes to generate a warning.

The 10 minute and 5 minute time conditions in this example help distinguish an erratic condition from a true scenario. You set time requisites to ensure that the metric conditions are valid and not caused by incidental spikes.

Triggered alarms reset when the triggering condition or state is no longer true. For example, if you have an alarm defined to trigger a warning when host CPU is above 75%, the condition will reset to normal when the value falls below the 75% and the warning alarm will no longer be triggered. The threshold condition is dependent on any tolerance range you set for the threshold.

Virtual Machine Condition and State Triggers

VMware provides default triggers that you can use to define alarms on virtual machines when they undergo certain conditions and states.

Table 21-4 lists the Condition and State triggers you can set on virtual machines.

Table 21-4. Virtual Machine Condition and State Alarm Triggers

Trigger Type	Trigger Name	Description
Condition	CPU Ready Time (ms)	The amount of time the virtual machine was ready during the collection interval, but could not get scheduled to run on the physical CPU. CPU ready time is dependent on the number of virtual machines on the host and their CPU loads.
Condition	CPU Usage (%)	Amount of virtual CPU (MHz) used by the virtual machine. CPU limits are ignored in the calculation. The calculation is: VM CPU Usage (%) = VM CPU [MHz] / (# of vCPUs x clock rate of the physical CPU [MHz]) x 100
Condition	Disk Aborts	Number of SCSI commands that were not completed on each physical disk of the virtual machine.
Condition	Disk Resets	Number of SCSI-bus reset commands issued on each physical disk of the virtual machine.
Condition	Disk Usage (KBps)	Sum of the data read and written across all disk instances on the virtual machine.

Table 21-4. Virtual Machine Condition and State Alarm Triggers (Continued)

Trigger Type	Trigger Name	Description
Condition	Fault Tolerance Secondary VM Latency Status Changed	Amount of wallclock time that the virtual CPU of the secondary virtual machine is behind the virtual CPU of the primary virtual machine. ■ Low – 0-2 seconds ■ Moderate – 2-6 seconds ■ High – More than 6 seconds
State	Heartbeat	Current status of the guest operating system heartbeat: ■ Gray – VMware Tools are not installed or not running. ■ Red – No heartbeat. Guest operating system may have stopped responding. ■ Yellow – Intermittent heartbeat. A Yellow status may be caused by heavy guest OS usage. ■ Green – Guest operating system is responding normally.
Condition	Memory Usage (%)	Amount of configured RAM (MB) used by the virtual machine. The calculation is: VM Memory Usage (%) = Active Memory [MB] / configured RAM of VM [MB] x 100
Condition	Network Usage (Kbps)	Sum of data transmitted and received across all virtual NIC instances on the virtual machine.
Condition	Snapshot Size (GB)	Aggregate size (KB) of all snapshots taken for the current virtual machine.
State	State	Current state of the virtual machine: ■ Powered On – The virtual machine is powered on. ■ Powered Off – The virtual machine is powered off. ■ Suspended – The virtual machine is suspended.
Condition	Total Disk Latency (ms)	Average amount of time taken to process a SCSI command issued by the Guest OS to the virtual machine. The calculation is: Total Disk Latency = kernelLatency + deviceLatency ■ Low – 0-2 seconds ■ Moderate – 2-6 seconds ■ High – More than 6 seconds
Condition	Total Size on Disk (GB)	Aggregate amount of disk space occupied by all virtual machines on the host.

Host Condition and State Triggers

VMware provides preconfigured alarms that trigger when hosts undergo certain conditions and states.

Table 21-5 lists the default Condition and State triggers you can set on hosts.

Table 21-5. Host Condition and State Triggers

Trigger Name	Description	Trigger Type
Connection State	Current connection state of the host: ■ Connected – The host is connected to the server. For ESX/ESXi hosts, this is always the state. ■ Disconnected – A user has explicitly shut down the host. In this state, vCenter Server does not expect to receive heartbeats from the host. The next time a heartbeat is received, the host is returned to a connected state and an event is logged. ■ Not Responding – vCenter Server is not receiving heartbeat messages from the host. After the heartbeat messages are received again, the state automatically changes to Connected. This state is often used to trigger an alarm on the host.	State
Console SwapIn Rate (KBps)	Rate at which the service console kernel is swapping in memory. The Console Swapin Rate indicates memory pressure in the service console. A high value is generally a precursor to timeout operations. To fix the problem, consider adding more memory or ending the memory-intensive task.	Condition
Console SwapOut Rate (KBps)	Rate at which the service console kernel is swapping out memory. The Console Swapout Rate indicates memory pressure in the service console. A high value is generally a precursor to timeout operations. To fix the problem, consider adding more memory or ending the memory-intensive task.	Condition
CPU Usage (%)	Amount of physical CPU (MHz) used by the ESX/ESXi host. The calculation is: Host CPU Usage (%) = CPU usage [MHz] / (# of physical CPUs x clock rate [MHz]) x 100	Condition
Disk Usage (KBps)	Sum of the data read from and written to all disk instances on the host.	Condition
Memory Usage (%)	Amount of physical RAM (MB) consumed by the ESX/ESXi host. The calculation is: Host Memory Usage (%) = Consumed Memory [MB] / physical RAM of server [MB] x 100	Condition
Network Usage (kbps)	Sum of data transmitted and received for all the NIC instances of the host.	Condition
Power State	Current power state of the host: ■ Powered On – The host is powered on. ■ Powered Off – The host is powered off. ■ Suspended – The host is suspended.	State
Swap Pages Write (KBps)	Rate at which host memory is swapped out to the disk.	Condition

Datastore Condition and State Triggers

VMware provides preconfigured alarms that trigger when datastores undergo certain conditions and states.

Table 21-6 lists the default Condition and State triggers you can set on datastores.

Table 21-6. Datastore Condition and State Triggers

Trigger Type	Trigger Name	Description
Condition	Datastore Disk Overallocation (%)	Amount of overallocated disk space in the datastore.
Condition	Datastore Disk Usage (%)	Amount of disk space (KB) used by the datastore. NOTE This alarm controls the **Status** value for datastores in vSphere Client. If you disable this alarm, the datastore status will be displayed as **Unknown**.
State	Datastore State to All Hosts	■ Connected to all hosts – The datastore is connected to at least one host. ■ Disconnected from all hosts – The datastore is disconnected from at least one host.

Event Triggers

Event triggers monitor events that occur in response to actions related to managed objects, the vCenter Server system, and the License Server.

Event triggers use arguments, operators, and values to monitor operations that occur in the vServer System. Because the occurrance of the event gives you information about the operation occurring in your environment, you usually will not need to configure arguments for them. However, some events are general and configuration might be required to set the alarm on the desired information. For example, the Hardware Health Changed event occurs for a variety of different subsystems on a host.The preconfigured datacenter alarm Host Hardware Fan Health uses the Hardware Health Changed event with the following two arguments to set a warning condition when a fan is not operating:

Table 21-7. Example – Event Arguments, Operators, and Values

Argument	Operator	Value
group	equal to	Fan
newState	equal to	Yellow

NOTE Due to the large number of events tracked by vCenter Server, the event table for each object does not contain definitive lists of events. Instead, it provides a subset of the events available for alarm triggers.

Event Trigger Components

Event triggers are composed of a trigger type, a trigger status, and triggering conditions.

Table 21-8 describes the components of event alarm triggers.

Table 21-8. Event Trigger Components

Trigger Component	Description
Trigger type	Event to monitor. Events can be generated by a user action or the system, for example, Account Password Change and Alarm Email Sent.
Status	The value that must be met for the alarm to trigger: ■ Normal ■ Warning ■ Alert.
Conditions	Specifications that define the trigger. Event conditions include the following components: ■ Argument – The event attribute to monitor. ■ Operator – The qualifier used to set the trigger value, for example **Starts with** and **Doesn't start with**. ■ Value – The value that must be met to trigger the event. Conditions are not configurable for all events.

For example, you have a subset of hosts in the same datacenter named with the identifying prefix, `QA_`. To trigger an alarm when any of these hosts lose network connectivity, create an alarm on the datacenter to monitor the event `Lost Network Connectivity`. The trigger conditions are:

- Argument — `host.name`
- Operator — `Starts with`
- Value – `QA_`

When storage connectivity is lost on a host named QA_Host1, the event triggers.

Event triggers do not rely on thresholds or durations. They use the arguments, operators, and values to identify the triggering condition. When the triggering conditions are no longer true, a triggered alarm resets automatically, and no longer triggers.

Virtual Machine Event Triggers

VMware provides preconfigured alarms that trigger when events occur on virtual machines.

Table 21-9 lists events you can use to trigger alarms on virtual machines.

Table 21-9. Virtual Machine Event Triggers

Event Category	Available Events
Customization	Customization started, Customization succeeded, Cannot complete Sysprep, Unknown error.
Deployment	VM created, VM auto renamed, VM being closed, VM being creating, VM deploying, VM emigrating, VM hot migrating, VM migrating, VM reconfigured, VM registered, VM removed, VM renamed, VM relocating, VM upgrading. Cannot complete clone, Cannot migrate, Cannot relocate, Cannot upgrade.
DRS	DRS VM migrated, VM powered on, No maintenance mode DRS recommendation.
Fault tolerance	Secondary VM added, Secondary VM disabled, Secondary VM enabled, Secondary VM started. vCenter cannot start secondary VM, vCenter cannot update secondary VM configuration, vCenter disabled fault tolerance. Fault tolerance state changed, Fault tolerance turned off, Fault tolerance VM deleted. No compatible host for secondary VM. Reached maximum Secondary VM (with FT turned On) restart count.

Table 21-9. Virtual Machine Event Triggers (Continued)

Event Category	Available Events
General messages and information	VM error, VM error message, VM information, VM information message, VM warning, VM warning message, VM migration error, VM migration warning, VM configuration missing.
HA	HA enabled VM reset, No HA enabled port groups, Cannot resent HA enabled VM, VM HA updated error.
Naming and IDs	UUID: Assigned, Changed, Conflict. Assign a new instance, Instance changed, Instance conflict. MAC: Assigned, Changed, Conflict. VM static MAC conflict. WWN: Assigned, Changed, Conflict.
Power and connection states	VM connected, VM disconnected, VM discovered, VM powered off, VM powered on, VM starting, VM stopping, VM suspended, VM restarted on alternate host, VM resuming. Guest reboot, guest shutdown, guest standby. Cannot power off, Cannot power on, Cannot reboot guest OS, Cannot reset, Cannot shut down the guest OS, Cannot standby guest OS, Cannot suspend. Remote console connected, Remote console disconnected.
Record, Replay	Start a recording session, Start a replay session.
Resource Pool	Resource pool moved, Resource pool relocated.

Host Event Triggers

VMware provides preconfigured alarms that trigger when events occur on hosts.

Table 21-10 lists events you can use to trigger alarms on hosts.

Table 21-10. Host Event Triggers

Event Category	Available Events
Accounts	Account created, Account removed, Account updated.
Access and security	Administrator access disabled, Administrator access enabled. Administrator password not changed. VIM account password changed. License expired, No license.
Connection and mode	Host connected, Host disconnected. Host entered maintenance mode, Host exited maintenance mode, Host entering standby mode, Host exiting standby mode. Cannot connect host, cannot get host short name, Host already managed, Incorrect Ccagent, Incorrect user name, Incompatible version, Ccagent upgrade, Network error, No access. Connection lost, Cannot reconnect host, Host connection failure, Network connectivity lost, Network uplink redundancy degraded, Network uplink redundancy lost, Cannot connect to storage.
DRS	DRS entering standby mode, DRS exited standby mode, DRS exiting standby mode. Cannot complete DRS resource configuration, Resource configuration synchronized.
DVS	Distributed Virtual Switch joined the port group, Distributed Virtual Switch left the port group, Distributed Virtual Switch does not exist in vCenter or does not contain this host.
General error information	Host error, Host information, Host warning.
HA	Host HA agent disabled, HA agent enabled, Disabling HA, Enabling HA agent, HA agent error, HA agent configured. Host has extra HA networks, Host has no available HA networks, Host is missing HA networks, No redundant management network for host, No HA enabled port groups.
Hardware health	Hardware health changed
Inventory	Host added, Host not in cluster. No datastores configured.

Table 21-10. Host Event Triggers (Continued)

Event Category	Available Events
IP address	Host IP changed, IP inconsistent, IP to short name not completed, Cannot get short host name, Short name to IP not completed, Duplicate IP detected.
vCenter Agent	Cannot complete vCenter Agent, Cannot uninstall vCenter Agent.

Datastore Event Triggers

VMware provides preconfigured alarms that trigger when events occur on datastores.

Table 21-11 lists events you can use to trigger alarms on datastores.

Table 21-11. Datastore Event Triggers

Event Category	Available Events
Datastore modification	Datastore capacity increased. Local datastore created, Datastore deleted, Datastore discovered, Datastore removed from host.
File system operations	File or directory copied to datastore, File or directory deleted from datastore, File or directory moved to datastore.
NAS	NAS datastore created.
VMFS	VMFS datastore created, VMFS datastore expanded, VMFS datastore extended.

Datacenter Event Triggers

VMware provides preconfigured alarms that trigger when events occur on datacenters.

Table 21-12 lists events you can use to set alarms on datacenters.

Table 21-12. Datacenter Event Triggers

Event Category	Available Events
Alarms	Alarm created, reconfigured, removed. Alarm email sent, email send failed. Alarm script completed, script not completed. Alarm SNMP trap sent, SNMP trap not completed. Alarm status changed.
Authentication, Permissions, and Roles	Already authenticated. Permission added, removed, updated. Profile created, removed. Role added, created, removed.
Custom Fields	Custom field definition added, removed, renamed. Custom field value changed. cannot complete customization network setup.
Customization	Customization Linux identity failed, network setup failed.
Datacenter	Datacenter created, renamed.
Datastore	Datastore renamed, datastore renamed on host.
DRS	DRS invocation not completed, DRS recovered from failure.
DVS	vNetwork Distributed Switch merged, renamed, configuration on some hosts differed from that of the vCenter Server.
HA and DRS	HA agent found, DRS invocation not completed, DRS recovered from failure.
Hosts	Host add failed, inventory full, short name inconsistent, cannot add host.
Licensing	License added, assigned, expired, insufficient, removed, unassigned. License server available, unavailable. Unlicensed virtual machines, all virtual machines licensed.
Scheduled Tasks	Scheduled task created, completed, cannot complete, email sent, email not sent, reconfigured, removed, started.
Templates	Upgrading template, template upgraded, cannot upgrade template.

Table 21-12. Datacenter Event Triggers (Continued)

Event Category	Available Events
User Operations	User assigned to group, removed from group, login, logout, upgrade.
Virtual Machines	VM cloned, created, relocated, upgraded.
vServer	Server license expired, session started, session stopped.

Cluster Event Triggers

VMware provides preconfigured alarms that trigger when events occur on clusters.

Table 21-13 lists events that you can use to set alarms on clusters.

Table 21-13. Cluster Event Triggers

Event Category	Available Events
Cluster creation, modification, and compliance	Cluster created, Cluster deleted, Cluster overcommitted, Cluster reconfigured. Cluster status changed, Cluster compliance checked.
High Availability (HA)	HA agent unavailable, HA disabled, HA enabled, HA host failed, HA host isolated, All HA hosts isolated.
DRS	DRS enabled, DRS disabled.

dvPort Group Event Triggers

VMware provides preconfigured alarms that trigger when events occur on dvPort group alarms.

Table 21-14 lists events you can use to set alarms on dvPort groups.

Table 21-14. dvPort Group Event Triggers

Event Category	Available Events
Distributed Virtual Port Group	Distributed virtual group created, Distributed virtual group deleted, Distributed virtual group reconfigured, Distributed virtual group renamed.

vNetwork Distributed Switch Event Triggers

VMware provides preconfigured alarms that trigger when events occur on on vNetwork distributed switches.

Table 21-15 lists the events you can use to set alarms on vNetwork distributed switches.

Table 21-15. vNetwork Distributed Switch Event Triggers

Event Category	Available Events
Distributed Virtual Switch creation, modification, and upgrade.	Distributed Virtual Switch created, Distributed Virtual Switch deleted, Distributed Virtual Switch reconfigured, Distributed Virtual Switch upgraded, Upgrade is available, Upgrade is in progress, Cannot complete the upgrade.
Distributed Virtual Switch port and distributed virtual port group operations	Distributed Virtual Switch port moved into the distributed virtual port group, Distributed Virtual Switch moved out of the distributed virtual port group.

Table 21-15. vNetwork Distributed Switch Event Triggers (Continued)

Event Category	Available Events
Port	Port blocked, Port unblocked, Port connected, Port disconnected, Port created, Port deleted, Port link up, Port link down, Port reconfigured.
Host	Host joined the Distributed Virtual Switch, Host left the Distributed Virtual Switch. Host and vCenter Server configuration was synchronized, Host and vCenter Server configuration differs.

Network Event Triggers

VMware provides preconfigured alarms that trigger when events occur on networks.

Table 21-16 lists the events you can use to trigger alarms on networks.

Table 21-16. Network Event Triggers

Event Category	Available Events
dvPort group creation and modification	dvPort group created, dvPort group deleted, dvPort group reconfigured, dvPort group renamed.

Alarm Actions

Alarm actions are operations that occur in response to triggered alarms. For example, email notifications are alarm actions.

VMware provides a list of preconfigured actions you can associate with an alarm. These actions are specific to the object on which you set the alarm. For example, preconfigured alarm actions for hosts include rebooting the host and putting the host in maintenance mode. Alarm actions for virtual machines include powering on, powering off, and suspending the virtual machine.

Although the actions are preconfigured, you must manually set up certain aspects of the action, such as having the action occur when a warning is triggered or when an alert is triggered, and whether to repeat the action. You can configure alarm actions to repeat in the following ways:

- At a specified time interval after an alarm triggers. For example, if an alarm triggers because a physical host is not responding, you can have an email message sent every 10 minutes until the host is returned to a connected state or until the alarm trigger is suppressed.
- Until the alarm is explicitly acknowledged by an administrator. When you acknowledge an alarm, the alarm actions are suppressed. The alarm trigger is not reset. It remains in its current state until the triggering condition, state, or event is no longer valid.

Some alarm actions, such as sending notification emails or traps, and running a script, require additional configuration.

NOTE The default VMware alarms do not have actions associated with them. You must manually associate actions with the default alarms.

Default vSphere Alarm Actions

VMware provides default alarm actions that you can associate with an alarm. When the alarm triggers, the action occurs.

Table 21-17 lists the default vSphere alarm actions.

Table 21-17. Default vSphere Alarm Actions

Action	Description	Alarm Object
Send a notification email	SMTP sends an email message. The SMTP must be ready when the email message is sent. You can set SMTP through vCenter Server.	datacenter, datastore, cluster, host, resource pool, virtual machine, network, vNetwork distributed switch, dvPort group
Send a notification trap	SNMP sends a notification trap. vCenter Server is the default SNMP notification receiver. An SNMP trap viewer is required to view a sent trap. The default hardware health alarms are configured to send 39SNMP traps.	datacenter, datastore, cluster, host, resource pool, virtual machine
Run a command	Performs the operation defined in the script you specify. It runs as separate process and does not block vCenter Server processes.	datacenter, datastore, cluster, host, resource pool, virtual machine, network, vNetwork distributed switch, dvPort group
Enter or exit maintenance mode	Puts the host in and out of maintenance mode. Maintenance mode restricts virtual machine operations on the host. You put a host in maintenance mode when you need to move or service it.	host
Enter or exit standby	Suspends or resumes the guest operating system on the virtual machine.	host
Reboot or shut down host	Reboots or shuts down the host.	host
Suspend the virtual machine	Suspends the virtual machine when the alarm triggers. You can use the suspend feature to make resources available on a short-term basis or for other situations in which you want to put a virtual machine on hold without powering it down.	virtual machine
Power on or power off the virtual machine	Power on starts the virtual machine and boots the guest operating system if the guest operating system is installed. Power off is analogous to pulling the power cable on a physical machine. It is not a graceful shutdown of the guest operating system, but is used when a shut down might not succeed. For example, a shut down will not work if the guest operating system is not responding.	virtual machine
Reset the virtual machine	Pauses activity on the virtual machine. Transactions are frozen until you issue a Resume command.	virtual machine
Migrate the virtual machine	Powers off the virtual machine and migrates it according to the settings you define when you created the alarm action.	virtual machine
Reboot or shutdown the guest	Reboot shuts down and restarts the guest operating system without powering off the virtual machine. Shutdown shuts down the guest operating system gracefully.	virtual machine

Disabling Alarm Actions

You can disable an alarm action from occurring without disabling the alarm itself. For example, if you have an alarm set to trigger when a host is disconnected, and you put the host in maintenance mode, you can disable the alarm action from firing because you know the host is not available. The alarm is still enabled, so it triggers, but the action does not.

You disable alarm actions for a selected inventory object. You can also disable alarm actions across multiple objects at one time from the object tab. For example, to disable the alarm actions for multiple virtual machines on a host, go to the **Virtual Machines** tab of the host. When you disable the alarm actions for an object, they continue to occur on child objects.

When you disable alarm actions, all actions on all alarms for the object are disabled. You cannot disable a subset of alarm actions.

SNMP Traps as Alarm Actions

The SNMP agent included with vCenter Server can be used to send traps when alarms are triggered on a vCenter Server. The default hardware health alarms send SNMP traps by default.

When an SNMP trap notification occurs, only one trap is triggered and one notification is sent.Table 21-18 describes the trap information provided in the body of an SNMP notification.

Table 21-18. SNMP Trap Notification Details

Trap Entry	Description
Type	The state vCenter Server is monitoring for the alarm. Options include Host Processor (or CPU) usage, Host Memory usage, Host State, Virtual Machine Processor (or CPU) usage, Virtual Machine Memory usage, Virtual Machine State, Virtual Machine Heartbeat.
Name	The name of the host or virtual machine that triggers the alarm.
Old Status	The alarm status before the alarm was triggered.
New Status	The alarm status when the alarm is triggered.
Object Value	The object value when the alarm is triggered.

NOTE To use SNMP with vCenter Server, you must configure SNMP settings using the vSphere Client.

Email Notifications as Alarm Actions

The SMTP agent included with vCenter Server can be used to send email notifications when alarms are triggered on vCenter Server. When an alarm is triggered, any number of email notification are sent. You define the recipient list when you set up the alarm actions for an alarm.

Table 21-19 describes the information provided in the body of an SMTP notification.

Table 21-19. SMTP Email Notification Details

Email Entry	Description
Target	Object for which the alarm was triggered.
Old Status	Previous alarm status. Applies only to state triggers.
New Status	Current alarm status. Applies only to state triggers.
Metric Value	Threshold value that triggered the alarm. Applies only to metric condition triggers.

Table 21-19. SMTP Email Notification Details (Continued)

Email Entry	Description
Alarm Definition	Alarm definition in vCenter Server, including the alarm name and status.
Description	Localized string containing a summary of the alarm. For example: `Alarm New_Alarm on host1.vmware.com changed from Gray to Red.`

If the alarm was triggered by an event, the information in Table 21-20 is also included in the body of the email.

Table 21-20. Event Details in Email

Detail	Description
Event Details	VMODL event type name.
Summary	Alarm summary, including the event type, alarm name, and target object.
Date	Time and date the alarm was triggered.
UserName	Person who initiated the action that caused the event to be created. Events caused by an internal system activity do not have a UserName value.
Host	Host on which the alarm was triggered.
Resource Pool	Resource pool on which the alarm was triggered.
Datacenter	Datacenter on which the alarm was triggered.
Arguments	Arguments passed with the alarm and their values.

Running Scripts as Alarm Actions

You can write scripts and attach them to alarms so that when the alarm triggers, the script runs.

Use the alarm environment variables to define complex scripts and attach them to multiple alarms or inventory objects. For example, you can write a script that enters the following trouble ticket information into an external system when an alarm is triggered:

- Alarm name
- Object on which the alarm was triggered
- Event that triggered the alarm
- Alarm trigger values

When you write the script, include the following environment variables in the script:

- VMWARE_ALARM_NAME
- VMWARE_ALARM_TARGET_NAME
- VMWARE_ALARM_EVENTDESCRIPTION
- VMWARE_ALARM_ALARMVALUE

You can attach the script to any alarm on any object without changing the script.

Alarm Environment Variables

To simplify script configuration for alarm actions, VMware provides environment variables for VMware alarms.

Table 21-21 lists the default environment variables defined for alarms. Use these variables to define more complex scripts and attach them to multiple alarms or inventory objects so the action occurs when the alarm triggers.

Table 21-21. Alarm Environment Variables

Variable Name	Variable Description	Supported Alarm Type
VMWARE_ALARM_NAME	Name of the triggered alarm.	Condition, State, Event
VMWARE_ALARM_ID	MOID of the triggered alarm.	Condition, State, Event
VMWARE_ALARM_TARGET_NAME	Name of the entity on which the alarm triggered.	Condition, State, Event
VMWARE_ALARM_TARGET_ID	MOID of the entity on which the alarm triggered.	Condition, State, Event
VMWARE_ALARM_OLDSTATUS	Old status of the alarm.	Condition, State, Event
VMWARE_ALARM_NEWSTATUS	New status of the alarm.	Condition, State, Event
VMWARE_ALARM_TRIGGERINGSUMMARY	Multiline summary of the alarm.	Condition, State, Event
VMWARE_ALARM_DECLARINGSUMMARY	Single-line declaration of the alarm expression.	Condition, State, Event
VMWARE_ALARM_ALARMVALUE	Value that triggered the alarm.	Condition, State
VMWARE_ALARM_EVENTDESCRIPTION	Description text of the alarm status change event.	Condition, State
VMWARE_ALARM_EVENTDESCRIPTION	Description of the event that triggered the alarm.	Event
VMWARE_ALARM_EVENT_USERNAME	User name associated with the event.	Event
VMWARE_ALARM_EVENT_DATACENTER	Name of the datacenter in which the event occurred.	Event
VMWARE_ALARM_EVENT_COMPUTERESOURCE	Name of the cluster or resource pool in which the event occurred.	Event
VMWARE_ALARM_EVENT_HOST	Name of the host on which the event occurred.	Event
VMWARE_ALARM_EVENT_VM	Name of the virtual machine on which the event occurred.	Event
VMWARE_ALARM_EVENT_NETWORK	Name of the network on which the event occurred.	Event
VMWARE_ALARM_EVENT_DATASTORE	Name of the datastore on which the event occurred.	Event
VMWARE_ALARM_EVENT_DVS	Name of the vNetwork Distributed Switch on which the event occurred.	Event

Alarm Command-Line Parameters

VMware provides command-line parameters that function as a substitute for the default alarm environment variables. You can use these parameters when running a script as an alarm action for a condition, state, or event alarm.

The command-line parameters enable you to pass alarm information without having to change an alarm script. For example, use these parameters when you have an external program for which you do not have the source. You can pass in the necessary data by using the substitution parameters, which take precedence over the environment variables. You pass the parameters through the vSphere Client Alarm Actions Configuration dialog box or on a command line.

Table 21-22 lists the command-line substitution parameters for scripts that run as alarm actions.

Table 21-22. Command-Line Parameters for Alarm Action Scripts

Variable	Description
`{eventDescription}`	Text of the alarmStatusChange event. The `{eventDescription}` variable is supported only for Condition and State alarms.
`{targetName}`	Name of the entity on which the alarm is triggered.
`{alarmName}`	Name of the alarm that is triggered.
`{triggeringSummary}`	Summary info of the alarm trigger values.
`{declaringSummary}`	Summary info of the alarm declaration values.
`{oldStatus}`	Alarm status before the alarm is triggered.
`{newStatus}`	Alarm status after the alarm is triggered.
`{target}`	Inventory object on which the alarm is set.

Alarm Reporting

Alarm reporting further restricts when a condition or state alarm trigger occurs by adding a tolerance range and a trigger frequency to the trigger configuration.

Tolerance Range

The tolerance range specifies a percentage above or below the configured threshold point, after which the alarm triggers or clears. A nonzero value triggers and clears the alarm only after the triggering condition falls above or below the tolerance range. A 0 (zero) value triggers and clears the alarm at the threshold point you configured.

vCenter Server uses the following calculation to trigger an alarm:

```
Condition threshold + Tolerance Range = Trigger alarm
```

For example, an alarm is defined to trigger a warning state when a host's CPU usage is above 70%. If you set the tolerance range to 5%, the warning state triggers only when CPU usage is above 75% (70 + 5) and resets to a normal state only when CPU usage falls below 65% (70 - 5).

The tolerance range ensures you do not transition alarm states based on false changes in a condition.

Trigger Frequency

The trigger frequency is the time period during which a triggered alarm action is not reported again. When the time period has elapsed, the alarm action occurs again if the condition or state is still true. By default, the trigger frequency for the default VMware alarms is set to 5 minutes.

For example, if the Host CPU Usage alarm triggers for a warning state at 2 p.m. and an alert state occurs at 2:02 p.m, the alert state is not reported at 2:02 p.m. because the frequency prohibits it. If the warning state is still true at 2:05 p.m., the alarm is reported. This guards against repeatedly reporting insignificant alarm transitions.

Creating Alarms

Creating an alarm involves setting up general alarm settings, alarm triggers, trigger reporting, and alarm actions.

Required Privilege: **Alarms.Create Alarm**

You create an alarm by using the Alarm Settings dialog box. You can open this dialog box by selecting the object in the inventory and using any of the following methods.

- Select **File > New > Alarm**.
- Select **Inventory > <*object_type*> > Alarm > Add Alarm**.
- Right-click the object and select **Alarm > Add Alarm**.
- In the **Alarms** tab, click the **Definitions** tab, right-click in the pane, and select **New > Alarm**.
- Select the object in the inventory and press Ctrl+A.

Prerequisites

To set up an alarm on an object, the vSphere Client must be connected to a vCenter Server system. In addition, you must have proper user permissions on all relevant objects to create alarms. After an alarm is created, it will be enabled even if the user who created it no longer has permissions.

Procedure

1 Alarm Settings – General on page 254

Use the **General** tab of the Alarm Settings dialog box to set up general alarm information, such as the alarm name, description, monitoring type, and status.

2 Alarm Settings – Triggers on page 255

In the Alarm Settings dialog box, use the **Triggers** tab to add, edit, or remove alarm triggers. The procedure for setting up triggers depends on whether you are setting the trigger for a condition or state or for an event.

3 Alarm Settings – Reporting on page 257

In the Alarm Settings dialog box, use the **Reporting** tab to define a tolerance range and trigger frequency for condition or state triggers. Reporting further restricts when the trigger occurs.

Alarm Settings – General

Use the **General** tab of the Alarm Settings dialog box to set up general alarm information, such as the alarm name, description, monitoring type, and status.

Procedure

1 If necessary, display the Alarm Settings dialog box.

   a Display the object in the Inventory panel.

   b Select the object and press Ctrl-M.

2 On the **General** tab, enter an alarm name and alarm description.

3 In the Alarm Type box, define the type of alarm to create.

   a In the **Monitor** list, select the object on which to create the alarm.

   The objects in the **Monitor** list are determined by the object selected in the inventory.

   b Select how to monitor the object: for specific conditions or states, or for specific events.

   This determines which triggers are available for the alarm.You can monitor hosts, virtual machines, and datastores for conditions, states, and events. All other objects are monitored only for events.

4 (Optional) To enable the alarm, select **Enable this alarm**.

You can enable an alarm at anytime after you create it.

5 (Optional) To define the alarm triggers, click the **Triggers** tab.

6 (Optional) To save general edits without updating the alarm triggers or alarm actions, click **OK**.

NOTE You cannot save an alarm if it does not have triggers defined for it.

Alarm Settings – Triggers

In the Alarm Settings dialog box, use the **Triggers** tab to add, edit, or remove alarm triggers. The procedure for setting up triggers depends on whether you are setting the trigger for a condition or state or for an event.

- Set Up a Condition or State Trigger on page 255

  Condition and state triggers monitor performance metrics and object states, such as CPU usage and connection states. You can only monitor hosts, virtual machines, and datastores with condition and state triggers.

- Set Up an Event Trigger on page 256

  Event triggers monitor events that occur on managed objects, vCenter Server, and the License Server. An event is recorded for any action that is of interest to vCenter Server.

Set Up a Condition or State Trigger

Condition and state triggers monitor performance metrics and object states, such as CPU usage and connection states. You can only monitor hosts, virtual machines, and datastores with condition and state triggers.

Procedure

1 If necessary, display the **Triggers** tab of the Alarm Settings dialog box.

   a Display the object in the Inventory panel.

   b Select the object and press Ctrl-M to open the Alarm Settings dialog box.

   c Click the **Triggers** tab.

2 Click **Add**.

   A default condition trigger is added to the triggers list.

3 If you do not want to use the default trigger, replace it.

   a Select the default trigger.

   b Double-click the **Trigger Type** list arrow to open the trigger list.

   c Select a trigger.

4 For a condition trigger, define the condition lengths.

   Double-click each attribute field—**Condition**, **Warning**, **Condition Length**, **Alert**, **Condition Length**—and select or enter values. Not all condition triggers have condition lengths.

   State triggers occur immediately when the state is reached. You cannot define condition lengths for state alarms.

5 (Optional) Define multiple conditions for the same trigger type.

   a Repeat Step 2 through Step 3, and select the same trigger you just configured.

   b Set values for each attribute.

6 (Optional) To define additional condition or state triggers, repeat Step 2 through Step 5.

NOTE You cannot use the **VM Total Size on Disk** and **VM Snapshot Size** triggers in combination with other triggers.

7 Below the triggers list, select one of the following options to specify how to trigger the alarm.

- If any conditions are satisfied (default).
- If all conditions are satisfied.

8 Click **OK**.

Set Up an Event Trigger

Event triggers monitor events that occur on managed objects, vCenter Server, and the License Server. An event is recorded for any action that is of interest to vCenter Server.

Procedure

1 If necessary, display the **Triggers** tab of the Alarm Settings dialog box.

a Display the object in the Inventory panel.

b Select the object and press Ctrl-M to open the Alarm Settings dialog box.

c Click the **Triggers** tab.

2 Click **Add**.

A default event trigger is added to the triggers list.

3 To replace the default event, double-click the event name and in the **Event** list, select an event.

If you know the event name, you can type it in the Event field to filter the list.

4 To change the default status for the event trigger, double-click the status name and in the **Status** list, select a status.

NOTE To set an alarm to trigger when more than one status has been reached, configure each event status separately. For example, to trigger a warning when a host's hardware health changes and an alert when a host's hardware health changes, configure two Hardware Health Changed events, one with a warning status and one with an alert status.

---

5 (Optional) To configure custom conditions for the event trigger, in the **Condition** column, click **Advanced** to open the Trigger Conditions dialog box.

a Click **Add**.

A default argument is added to the Event Arguments list.

b To replace the default argument, double-click the argument name and in the argument list, select an argument.

c To replace the default operator, double-click the operator name and select an operator from the list.

d Click the Value field and type a value.

e (Optional) To define multiple conditions for the same trigger, repeat Step 5.

f Click **OK**.

6 (Optional) To define additional event triggers, repeat this task.

7 Click **OK**.

Alarm Settings – Reporting

In the Alarm Settings dialog box, use the **Reporting** tab to define a tolerance range and trigger frequency for condition or state triggers. Reporting further restricts when the trigger occurs.

Procedure

1 If necessary, display the **Reporting** tab of the Alarm Settings dialog box.

   a Display the object in the Inventory panel.

   b Select the object and press Ctrl-M to open the Alarm Settings dialog box.

   c Click the **Reporting** tab.

2 Enter a **Tolerance**.

   A 0 value triggers and clears the alarm at the threshold point you configured. A non-zero value triggers the alarm only after the condition reaches an additional percentage above or below the threshold point.

   ```
   Condition threshold + Reporting Tolerance = trigger alarm
   ```

   Tolerance values ensure you do not transition alarm states based on false changes in a condition.

3 Select a **Frequency**.

   The frequency sets the time period during which a triggered alarm is not reported again. When the time period has elapsed, the alarm will report again if the condition or state is still true.

4 Click **OK**.

Managing Alarms

You can change alarms, disable alarms, reset alarms, and acknowledge triggered alarms. In addition, you can export a list of alarms to a file.

To manage alarms the vSphere Client must be connected to a vCenter Server system.

Acknowledge Triggered Alarms

Acknowledging a triggered alarm suppresses the alarm actions from occurring. It does not reset the alarm to a normal state.

Required privilege: **Alarm.Alarm Acknowledge**

Procedure

1 Display the inventory panel.

2 If necessary, select **View > Status Bar** to display the status pane.

3 In the status bar, click **Alarms** to display the Triggered Alarms panel.

4 Right-click the alarm and select **Acknowledge Alarm**.

5 (Optional) To acknowledge multiple alarms at one time, shift-click each alarm to select it, right-click the selection, and select **Acknowledge Alarm**.

Change Alarm Attributes

You can rename alarms and change alarm triggers, reporting, and actions.

Required privilege: **Alarm.Modify Alarm**

Procedure

1 Display the object in the inventory on which the alarm is defined.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

The Defined in column lists the object on which the alarm is defined. If the value is not **This object**, click the object name. The alarms list for the object opens in the **Alarms** tab.

4 Double-click the alarm to open the Alarm Settings dialog box.

5 Edit the alarm general settings, triggers, reporting, or actions, as needed.

For help on how to configure the values on each tab, click **Help**.

6 Click **OK**.

vCenter Server verifies the configuration of the alarm and updates the alarm for the selected object.

Disable Alarms

You disable alarms from the object on which they were defined. You can enable a disabled alarm at any time.

Required privilege: **Alarm.Modify Alarm**

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

If the Defined in column does not contain **This object** for the alarm to disable, it was not defined on the object selected in the inventory. To open the alarm definitions for that object, click the linked object in the Defined in column.

4 Double-click the alarm to open the Alarm Settings dialog box.

5 Deselect **Enable this alarm**.

6 Click **OK**.

Export a List of Alarms

You can export, to a system file, a list of alarms defined on any managed object in the inventory. The list of alarms for an object includes alarms set on all child objects.

Required privilege: **Read-Only**

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

4 Select **File > Export > Export List**.

5 In the Save As dialog box, specify the directory, file name, and file type for the exported file.

6 Click **Save**.

Identifying Triggered Alarms

You can identify triggered alarms in the vSphere Client Inventory panel, the Status bar, and the **Alarms** tab.

Table 21-23. Triggered Alarm Indicators in the vSphere Client

vSphere Client Location	Triggered Alarm Indicator
Inventory panel	An icon on the object where the alarm was triggered.
Status bar, Triggered Alarms panel	A list of alarms triggered on all inventory objects. Double-click an alarm to select the object in the inventory on which the alarm was triggered.
Alarms tab	A list of alarms triggered on the selected inventory object.

Remove Alarms

You remove alarms from the object on which they were defined. You cannot remove an alarm from a child object that inherited the alarm and you cannot remove the default VMware alarms.

When an alarm is removed, it is removed from vCenter Server and cannot be retrieved.

Required privilege: **Alarm.Remove Alarm**

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

If the Defined in column does not contain **This object** for the alarm to disable, it was not defined on the object selected in the inventory. To open the alarm definitions for that object, click the linked object in the Defined in column.

4 Select the alarm and select **Edit > Remove**.

5 Click **Yes**.

Reset Triggered Event Alarms

An alarm triggered by an event might not reset to a normal state if vCenter Server does not retrieve the event that identifies the normal condition. In such cases, reset the alarm manually to return it to a normal state.

Required privilege: **Alarm.Set Alarm Status**

Procedure

1 Locate the triggered alarm in the Triggered Alarms panel or on the **Alarms** tab for the object.

2 Right-click the alarm and select **Reset Alarm to Green**.

View Alarms

You view alarms that have been triggered on objects and those that have been defined on objects in the vSphere Client **Alarms** tab.

The **Alarms** tab is available only when the vSphere Client is connected to a vCenter Server system. It has two views, **Triggered Alarms** and **Definitions**.

Triggered Alarms	Lists the alarms triggered on the selected object, including the status of the alarm, the date and time it was last triggered, and if the alarm was acknowledged.
Definitions	Lists the alarms associated with the selected object, including the alarm description and the object on which the alarm was defined.

There vSphere Client offers several different options for viewing alarms.

- View Alarms Defined on an Object on page 260
  The vSphere Client **Alarms** tab contains a list of alarms definitions for the object selected in the inventory.
- View Alarms Triggered on an Object on page 260
  You view triggered alarms on an object on the object's **Alarms** tab.
- View All Alarms Triggered in vCenter Server on page 260
  You view triggered alarms in the **Alarms** tab of the Status bar.

View Alarms Defined on an Object

The vSphere Client **Alarms** tab contains a list of alarms definitions for the object selected in the inventory.

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

The Defined In column displays the object on which the alarm was created.

View Alarms Triggered on an Object

You view triggered alarms on an object on the object's **Alarms** tab.

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Alarms** tab.

3 Click **Triggered Alarms**.

View All Alarms Triggered in vCenter Server

You view triggered alarms in the **Alarms** tab of the Status bar.

Procedure

1 Display the vSphere Client inventory.

2 If necessary, select **View > Status Bar** to display the status pane at the bottom of the vSphere Client.

3 In the Status bar, click **Alarms**.

The list of triggered alarms displays in the status pane.

What to do next

You can also view alarms for a selected inventory object in the Triggered Alarms pane of the **Alarms** tab.

Managing Alarm Actions

You can change alarm actions on the preconfigured vSphere alarms and on custom alarms. Use the vSphere Client to disable alarm actions, identify disabled alarm actions, remove alarm actions, and run commands as alarm actions.

To manage alarm actions, the vSphere Client must be connected to a vCenter Server system.

Disable Alarm Actions

Disabling an alarm action stops the action from occuring when the alarm triggers. It does not disable the alarm from triggering.

When you disable alarm actions on a selected inventory object, all actions for all alarms are disabled on that object. You cannot disable a subset of alarm actions. The alarm actions will continue to fire on the child objects.

Required privilege: **Alarm.Disable Alarm Action**

Procedure

1 Display the object in the inventory.

2 Right-click the object and select **Alarm > Disable Alarm Actions**.

The actions defined for the alarm will not occur on the object until they are enabled.

Enable Alarm Actions

Enabling alarm actions resumes all actions set for triggered alarms.

Required privilege: **Alarm.Disable Alarm Actions**

Procedure

1 Display the object in the inventory on which the alarm is defined.

2 Right-click the object and select **Alarm > Enable Alarm Actions**.

Managing Alarm Actions

You can change alarm actions on the preconfigured vSphere alarms and on custom alarms. Use the vSphere Client to disable alarm actions, identify disabled alarm actions, remove alarm actions, and run commands as alarm actions.

To manage alarm actions, the vSphere Client must be connected to a vCenter Server system.

Identifying Disabled Alarm Actions

The vSphere Client uses visual indicators to denote whether alarm actions are enabled or disabled.

When an object is selected in the inventory, you can identify its disabled alarm actions in the following areas of the vSphere user interface:

- In the General pane of the object's **Summary** tab.
- In the Alarm Actions Disabled pane of the **Alarms** tab.

- In the Alarm Actions column of the object's child object tabs. For example, if you select a host in the inventory, the **Virtual Machines** tab displays whether alarm actions are enabled or disabled for each virtual machine on the host.

Remove Alarm Actions

Removing an alarm action stops the action from occurring. It does not stop the alarm itself.

Remove an alarm action if you are certain you will not use again. If you are not sure, disable the alarm action instead.

Required privilege: **Alarm.Remove Alarm**

Procedure

1 Display the object in the inventory on which the alarm is defined.

2 Select the object and click the **Alarms** tab.

3 Click **Definitions**.

4 Right-click the alarm and select **Edit Settings** from the context menu.

If the **Edit Settings** option is not available, the object you selected is not the owner of the alarm. To open the correct object, click the object link in the Defined In column for the alarm. Then repeat this step.

5 In the Alarm Settings dialog box, click the **Actions** tab.

6 Select the action and click **Remove**.

7 Click **OK**.

Run a Command as an Alarm Action

You can run a script when an alarm triggers by configuring a command alarm action.

Required privilege: **Alarm.Modify Alarm**

NOTE Alarm commands run in other processes and do not block vCenter Server from running. They do, however, consume server resources such as processor and memory.This procedure assumes you are adding the alarm action to an existing alarm.

This procedure assumes you are adding the alarm action to an existing alarm.

Procedure

1 If necessary, open the Alarm Settings dialog box.

a Select the object in the inventory on which the alarm is set.

b Click the **Alarms** tab.

c Click **Definitions**.

d Double-click the alarm in the list.

2 Click the **Actions** tab.

3 Click **Add**.

4 Double-click the default action and select **Run a command**.

5 Double-click the **Configuration** field and do one of the following, depending on the command file type:

- If the command is a `.exe` file, enter the full pathname of the command. For example, to run the `cmd.exe` command in the `C:\tools` directory, type:**`c:\tools\cmd.exe`**.
- If the command is a `.bat` file, enter the full pathname of the command as an argument to the `c:\windows\system32\cmd.exe` command. For example, to run the `cmd.bat` command in the `C:\tools` directory, type:**`c:\windows\system32\cmd.exe /c c:\tools\cmd.bat`**.

  If your script does not make use of the alarm environment variables, include any necessary parameters in the configuration field. For example:

  ```
  c:\tools\cmd.exe AlarmName targetName
  c:\windows\system32\cmd.exe /c c:\tools\cmd.bat alarmName targetName
  ```

  For `.bat` files, the command and its parameters must be formatted into one string.

6 Click **OK**.

When the alarm triggers, the action defined in the script is performed.

Configure SNMP Settings for vCenter Server

To use SNMP with vCenter Server, you must configure SNMP settings using the vSphere Client.

Prerequisites

To complete the following task, the vSphere Client must be connected to a vCenter Server. In addition, you need the DNS name and IP address of the SNMP receiver, the port number of the receiver, and the community identifier.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If the vCenter Server is part of a connected group, in **Current vCenter Server**, select the appropriate server.

3 Click **SNMP** in the navigation list.

4 Enter the following information for the **Primary Receiver** of the SNMP traps.

Option	Description
Receiver URL	The DNS name and IP address of the SNMP receiver.
Receiver port	The port number of the receiver to which the SNMP agent sends traps. If the port value is empty, vCenter Server uses the default port, **162**.
Community	The community identifier.

5 (Optional) Enable additional receivers in the **Enable Receiver 2**, **Enable Receiver 3**, and **Enable Receiver 4** options.

6 Click **OK**.

The vCenter Server system is now ready to send traps to the management system you have specified.

What to do next

Configure your SNMP management software to receive and interpret data from the vCenter Server SNMP agent. See "Configure SNMP Management Client Software," on page 53.

Configure vCenter Server SMTP Mail Settings

You can configure vCenter Server to send email notifications as alarm actions.

Prerequisites

Before vCenter Server can send email, you must perform the following tasks:

- Configure the SMTP server settings for vCenter Server.
- Specify email recipients through the Alarm Settings dialog box when you configure alarm actions.

To perform this task, the vSphere Client must be connected to a vCenter Server.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If the vCenter Server system is part of a connected group, in **Current vCenter Server**, select the vCenter Server system to configure.

3 Select **Mail** in the navigation list.

4 For email message notification, set the SMTP server and SMTP port:

Option	Description
SMTP Server	The DNS name or IP address of the SMTP gateway to use for sending email messages.
Sender Account	The email address of the sender, for example, notifications@example.com.

5 Click **OK**.

Preconfigured VMware Alarms

VMware provides preconfigured alarms for the vCenter Server system that trigger automatically when problems are detected. You only need to set up actions for these alarms.

Table 21-24 lists the preconfigured alarms available for the vCenter Server system.

Table 21-24. Default VMware Alarms

Alarm Name	Description
Cannot Connect to Network	Monitors network connectivity on a vSwitch.
Cannot Connect to Storage	Monitors host connectivity to a storage device.
Cluster High Availability Error	Monitors high availability errors on a cluster.
Datastore Usage On Disk	Monitors datastore disk usage. NOTE This alarm controls the **Status** value for datastores in vSphere Client. If you disable this alarm, the datastore status is displayed as **Unknown**.
Exit Standby Error	Monitors whether a host cannot exit standby mode.
Health Status Changed	Monitors changes to service and extension health status.
Host Battery Status	Monitors host batteries.
Host Connection and Power State	Monitors host connection and power state.
Host Connection Failure	Monitors host connection failures.
Host CPU Usage	Monitors host CPU usage.
Host Error	Monitors host error and warning events.
Host Hardware Fan Status	Monitors host fans.

Table 21-24. Default VMware Alarms (Continued)

Alarm Name	Description
Host Hardware Power Status	Monitors host power.
Host Hardware System Board Status	Monitors host system boards.
Host Hardware Temperature Status	Monitors host temperature.
Host Hardware Voltage	Monitors host voltage.
Host Memory Status	Monitors host memory.
Host Memory Usage	Monitors host memory usage.
Host Processor Status	Monitors host processors.
Host Service Console SwapIn Rate	Monitors host service console memory swapin rate.
Host Service Console SwapOut Rate	Monitors host service console memory swapout rate.
Host Status for Hardware Objects	Monitors the status of host hardware objects.
Host Storage Status	Monitors host connectivity to storage devices.
License Error	Monitors license errors.
License Inventory Monitoring	Monitors the license inventory for compliancy.
Migration Error	Monitors whether a virtual machine cannot migrate or relocate, or is orphaned.
No Compatible Host For Secondary Virtual Machine	Monitors whether there are no compatible hosts available to place a secondary virtual machine.
Timed Out Starting Secondary Virtual Machine	Monitors timeouts when starting a Secondary virtual machine.
Virtual Machine CPU Usage	Monitors virtual machine CPU usage.
Virtual Machine Error	Monitors virtual machine error and warning events.
Virtual Machine Fault Tolerance Secondary Latency Status Changed	Monitors changes in latency status of a fault tolerance secondary virtual machine.
Virtual Machine Fault Tolerance State Changed	Monitors changes in the fault tolerance state of a virtual machine.
Virtual Machine High Availability Error	Monitors high availability errors on a virtual machine.
Virtual Machine Memory Usage	Monitors virtual machine memory usage.
Virtual Machine Total Disk Latency	Monitors virtual machine total disk latency.

Working with Performance Statistics 22

You can configure how statistics are collected and archived for your vCenter Server system. This determines the data available in the performance charts, which you use to monitor and troubleshoot performance in your environment.

This chapter includes the following topics:

- "Statistics Collection for vCenter Server," on page 267
- "Statistics Collection for Microsoft Windows Guest Operating Systems," on page 274
- "vCenter Server Performance Charts," on page 275
- "Monitoring and Troubleshooting Performance," on page 279

Statistics Collection for vCenter Server

You can collect statistical data for all managed objects in your vCenter Server system. Statistical data consists of CPU, memory, disk, network, system, and virtual machine operations metrics.

Table 22-1 lists each metric group and describes the type of data collected.

Table 22-1. Metric Groups

Metric group	Description
CPU	CPU utilization per host, virtual machine, resource pool, or compute resource.
Memory	Memory utilization per host, virtual machine, resource pool, or compute resource. The value obtained is one of the following: ■ For virtual machines, memory refers to guest physical memory. Guest physical memory is the amount of physical memory presented as a virtual-hardware component to the virtual machine, at creation time, and made available when the virtual machine is running. ■ For hosts, memory refers to machine memory. Machine memory is the random-access memory (RAM) that is installed in the hardware that comprises the ESX/ESXi system.
Disk	Disk utilization per host, virtual machine, or datastore. Disk metrics include input/output (I/O) performance (such as latency and read/write speeds), and utilization metrics for storage as a finite resource.
Network	Network utilization for both physical and virtual network interface controllers (NICs) and other network devices, such as the virtual switches (vSwitch) that support connectivity among all components (hosts, virtual machines, VMkernel, and so on).

Table 22-1. Metric Groups (Continued)

Metric group	Description
System	Overall system availability, such as system heartbeat and uptime. These counters are available directly from ESX and from vCenter Server.
Virtual Machine Operations	Virtual machine power and provisioning operations in a cluster or datacenter.

For a complete list of all statistics available for ESX/ESXi hosts and collected by vCenter Server, see the PerformanceManager API documentation pages in the *vSphere API Reference*.

Data Counters

vCenter Server and ESX/ESXi hosts use data counters to query for statistics. A data counter is a unit of information relevant to a given object.

For example, network metrics for a virtual machine include one counter that tracks the rate at which data is transmitted and another counter that tracks the rate at which data is received across a NIC instance.

To ensure performance is not impaired when collecting and writing the data to the database, cyclical queries are used to collect data counter statistics. The queries occur for a specified collection interval. At the end of each interval, the data calculation occurs.

Each data counter is comprised of several attributes that are used to determine the statistical value collected. Table 22-2 lists data counter attributes.

Table 22-2. Data Counter Attributes

Attribute	Description
Unit of Measurement	Standard in which the statistic quantity is measured. One of: ■ KiloBytes (KB) – 1024 bytes ■ KiloBytes per second (KBps) – 1024 bytes per second ■ Kilobits (kb) – 1000 bits ■ Kilobits per second (kbps) – 1000 bits per second ■ Megabytes (MB) ■ megabytes per second (MBps) ■ megabits (Mb), megabits per second (Mbps) ■ megahertz (MHz) ■ microseconds (μs) ■ milliseconds (ms) ■ number (#) ■ percent (%) ■ seconds (s)
Description	Text description of the data counter.
Statistics Type	Measurement used during the statistics interval. The statistics type is related to the unit of measurement. One of: ■ Rate – Value over the current statistics interval ■ Delta – Change from previous statistics interval. ■ Absolute – Absolute value (independent of the statistics interval).

Table 22-2. Data Counter Attributes (Continued)

Attribute	Description
Rollup Type	Calculation method used during the statistics interval to roll up data. This determines the type of statistical values that are returned for the counter. One of: ■ Average – Data collected during the interval is aggregated and averaged. ■ Minimum – The minimum value is rolled up. ■ Maximum – The maximum value is rolled up. The Minimum and Maximum values are collected and displayed only in collection level 4. Minimum and maximum rollup types are used to capture peaks in data during the interval. For real-time data, the value is the current minimum or current maximum. For historical data, the value is the average minimum or average maximum. For example, the following information for the CPU usage chart shows that the average is collected at collection level 1 and the minimum and maximum values are collected at collection level 4. ■ Counter: usage ■ Unit: Percentage (%) ■ Rollup Type: Average (Minimum/Maximum) ■ Collection Level: 1 (4) ■ Summation – Data collected is summed. The measurement displayed in the chart represents the sum of data collected during the interval. ■ Latest – Data collected during the interval is a set value. The value displayed in the performance charts represents the current value.
Collection level	Number of data counters used to collect statistics. Collection levels range from 1 to 4, with 4 having the most counters.

Collection Intervals

Collection intervals determine the time period during which statistics are aggregated and rolled up, and the length of time the statistics are archived in the vCenter database.

By default, vCenter Server has four collection intervals: **Day**, **Week**, **Month**, and **Year**. Each interval specifies a length of a time statistics are archived in the vCenter database. You can configure which intervals are enabled and for what period of time. You can also configure the number of data counters used during a collection interval by setting the collection level. Together, the collection interval and collection level determine how much statistical data is collected and stored in your vCenter Server database.

Real-time statistics are not stored in the database. They are stored in a flat file on ESX/ESXi hosts and in memory on the vCenter Server systems. ESX/ESXi hosts collect real-time statistics only for the host or the virtual machines available on the host. Real-time statistics are collected directly on an ESX/ESXi host every 20 seconds (60 seconds for ESX Server 2.x hosts). If you query for real-time statistics in the vSphere Client for performance charts, vCenter Server queries each host directly for the data. It does not process the data at this point. It only passes the data to the vSphere Client. The processing occurs in a separate operation. On ESX/ESXi hosts, the statistics are kept for one hour, after which 180 data points (15 - 20 second samples) will have been collected. The data points are aggregated, processed, and returned to vCenter Server. At this point, vCenter Server archives the data in the database as a data point for the **Day** collection interval.

To ensure performance is not impaired when collecting and writing the data to the database, cyclical queries are used to collect data counter statistics. The queries occur for a specified collection interval. At the end of each interval, the data calculation occurs.

Table 22-3 lists the default collection intervals available for the vCenter Server.

Table 22-3. Collection Intervals

Collection Interval/Archive Length	Collection Frequency	Default Behavior
1 Day	5 Minutes	Real-time statistics are rolled up to create one data point every 5 minutes. The result is 12 data points every hour and 288 data points every day. After 30 minutes, the six data points collected are aggregated and rolled up as a data point for the 1 Week time range. You can change the interval duration and archive length of the 1 Day collection interval by configuring the statistics settings.
1 Week	30 Minutes	1 Day statistics are rolled up to create one data point every 30 minutes. The result is 48 data points every day and 336 data points every week. Every 2 hours, the 12 data points collected are aggregated and rolled up as a data point for the 1 Month time range. You cannot change the default settings of the 1 Week collection interval.
1 Month	2 Hours	1 Week statistics are rolled up to create one data point every 2 hours. The result is 12 data points every day and 360 data points every month (assuming a 30-day month). After 24 hours, the 12 data points collected are aggregated and rolled up as a data point for the **1 Year** time range. You cannot change the default settings of the 1 Month collection interval.
1 Year	1 Day	1 Month statistics are rolled up to create one data point every day. The result is 365 data points each year. You can change the interval duration and archive length of the 1 Year collection interval by configuring the statistics settings.

Configure Collection Intervals

You can change the frequency at which statistic queries occur, the length of time statistical data is stored in the vCenter Server database, and the amount of statistical data collected. By default, all collection intervals are enabled and query for statistics at collection level 1.

Prerequisites

To configure statistics settings, the vSphere Client must be connected to a vCenter Server system.

NOTE Not all attributes are configurable for each collection interval.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If your environment uses multiple vCenter Servers, in **Current vCenter Server**, select the server.

3 In the navigation panel, select **Statistics**.

4 In the Statistics Intervals section, select or deselect a collection interval to enable or disable it.

Enabling a longer interval automatically enables all shorter intervals. If you disable all collection levels, statistical data is not archived in the vCenter Server database.

5 (Optional) To change a collection interval attribute, select its row in the Statistics Interval section and click **Edit** to open the Edit Collection Interval dialog box.

   a In **Keep Samples for**, select an archive length.

      This option is configurable only for the Day and Year intervals.

   b In **Statistics Interval**, select an interval duration.

      This option is configurable only for the Day interval.

   c In **Statistics Level** select a new level interval level.

      Level 4 uses the highest number of statistics counters. Use it only for debugging purposes.

      The statistics level must be less than or equal to the statistics level set for the preceeding statistics interval. This is a vCenter Server dependency.

6 (Optional) In the Database Size section, estimate the effect of the statistics settings on the database.

   a Enter the number of **Physical Hosts**.

   b Enter the number of **Virtual Machines**.

      The estimated space required and number of database rows required are calculated and displayed.

   c If necessary, make changes to your statistics collection settings.

7 Click **OK**.

Enable or Disable Collection Intervals

Enabling and disabling collection intervals controls the amount of statistical data saved to the vCenter Server database.

Prerequisites

To configure statistics settings, the vSphere Client must be connected to a vCenter Server system.

Procedure

1 Select **Administration > vCenter Server Settings**.

2 If your environment uses multiple vCenter Servers, in **Current vCenter Server**, select the appropriate server.

3 In the vCenter Server Settings dialog box, select **Statistics**.

4 In the Statistics Intervals section, select or deselect a collection interval to enable or disable it.

   NOTE When you disable a collection interval, all subsequent intervals are automatically disabled.

5 (Optional) In the Database Size section, estimate the effect of the statistics settings on the database.

   a Enter the number of **Physical Hosts**.

   b Enter the number of **Virtual Machines**.

      The estimated space required and number of database rows required are calculated and displayed.

   c If necessary, make changes to your statistics collection settings.

6 Click **OK**.

Collection Levels

Each collection interval has a default collection level that determines how many data counters are used when collecting statistics data.

The collection level establishes which metrics are retrieved and recorded in the vCenter Server database. You can assign a collection level of 1- 4 to each collection interval, with level 4 having the largest number of counters. By default, all collection intervals use collection level 1.

The collection level for an interval cannot be greater than the collection level set for the preceding collection interval. For example, if the Month interval is set to collection level 3, the Year interval can be set to collection level 1, 2, or 3, but not to collection level 4. This is a vCenter Server dependency.

Table 22-4 describes each collection level and provides recommendations on when to use them.

Table 22-4. Collection Levels

Level	Metrics	Best Practice
Level 1	■ Cluster Services (VMware Distributed Resource Scheduler) – all metrics ■ CPU – cpuentitlement, totalmhz, usage (average), usagemhz ■ Disk – capacity, maxTotalLatency, provisioned, unshared, usage (average), used ■ Memory – consumed, mementitlement, overhead, swapinRate, swapoutRate, swapused, totalmb, usage (average), vmmemctl (balloon) ■ Network – usage (average) ■ System – heartbeat, uptime ■ Virtual Machine Operations – numChangeDS, numChangeHost, numChangeHostDS	Use for long-term performance monitoring when device statistics are not required. Level 1 is the default Collection Level for all Collection Intervals.
Level 2	■ Level 1 metrics ■ CPU – idle, reservedCapacity ■ Disk – All metrics, excluding numberRead and numberWrite. ■ Memory – All metrics, excluding memUsed and maximum and minimum rollup values. ■ Virtual Machine Operations – All metrics	Use for long-term performance monitoring when device statistics are not required but you want to monitor more than the basic statistics.
Level 3	■ Level 1 and Level 2 metrics ■ Metrics for all counters, excluding minimum and maximum rollup values. ■ Device metrics	Use for short-term performance monitoring after encountering problems or when device statistics are required. Due to the large quantity of troubleshooting data retrieved and recorded, use level 3 for the shortest time period possible— the Day or Week collection interval.
Level 4	All metrics supported by the vCenter Server, including minimum and maximum rollup values.	Use for short-term performance monitoring after encountering problems or when device statistics are required. Due to the large quantity of troubleshooting data retrieved and recorded, use level 4 for the shortest amount of time possible.

Generally, you need to use only collection levels 1 and 2 for performance monitoring and analysis. Levels 3 and 4 provide granularity that is generally useful only for developers. Unless vCenter Server is set to a collection level that contains a data counter, the data for that counter is not stored in the database nor is it rolled up into a past-day statistic on the ESX/ESXi host. The counter will not appear in the performance charts.

Using Collection Levels Effectively

Using collection level 1 is generally adequate for monitoring performance. There are some instances in which you might need to collect more performance statistics, for example, to troubleshoot performance problems.

Before you increase the collection level for an interval, view charts in real-time. Viewing real-time data has less impact on performance because metrics are retrieved directly from the source without being written to the vCenter Server database.

If you change to collection level 3 or 4 to diagnose problems, reset the collection level to its previous state as soon as possible. At collection level 4, try to limit the collection period to the Day interval to not have an impact on the database. If you need to save the data for longer than one day, increase interval to two or three days rather than using the Week interval. For example, if you need to record data over the weekend, set the interval to three days. Use a week interval only when you need the duration to be more than three days.

Table 22-5 lists the circumstances in which you might want to increase the collection level for your vCenter Server.

Table 22-5. Collection Level Scenarios

Use Collection Level	To do this
2	■ Identify virtual machines that can be co-located because of complimentary memory sharing. ■ Detect the amount of active memory on a host to determine whether it can handle additional virtual machines.
3	■ Compare ready and wait times of virtual CPUs to determine the effectiveness of VSMP. ■ Diagnose problems with devices, or compare performance among multiple devices.
4	■ Determine whether a device is being saturated. ■ Troubleshoot errors.

How Metrics Are Stored in the vCenter Server Database

The metrics gathered for each collection interval are stored in their own database tables.

At the end of an interval, one of two things can occur.

- If the next interval is disabled, the data in the table that is older than the interval duration is purged.
- If the next interval is enabled, the data is aggregated into groups and is rolled up to the database table of the subsequent collection interval. For example, the day interval has a 5 minute collection frequency, and the week interval has a 30 minute collection frequency. When the day interval completes, it aggregates the 5 minute queries into groups of six (equaling 30 minutes) and rolls the 30-minute data block to the week interval database table. The day-old data is then purged from the database to make room for new queries.

You control how long statistical data is stored in the vCenter Server database by enabling or disabling a collection interval. When you disable a collection interval, all subsequent intervals are automatically disabled. For example, when you disable the week interval, the month and year intervals are also disabled. Data is purged at the end of the day interval cycle because no rollups can occur. The oldest data is purged first.

NOTE You must manually enable each collection interval to use it again. Also, you can only enable a collection interval if all previous collection intervals are enabled. For example, to enable the month interval, the day and week intervals must be enabled.

By default, statistics are stored in the vCenter Server database for one year. You can increase this to five years. To save statistical data for longer than five years, archive it outside of the vCenter Server database.

Estimate the Statistics Impact on the vCenter Server Database

After you configure collection intervals, you can verify that the vCenter Server database has enough space to archive the data collected.

Perform the following task in the vSphere Client.

Procedure

1 If necessary, open the **Statistics** tab of the vCenter Server Settings dialog box.

   a Select **Administration > vCenter Server Settings**.

   b In the navigation panel, click **Statistics**.

2 (Optional) Edit a statistics interval.

   a Select the interval to change.

   b Click **Edit**.

   c In the Edit Statistics Interval dialog box, change the settings as necessary.

   d Click **OK**.

3 Enter the number of physical hosts and virtual machines in your inventory.

   The vCenter Server uses a database calculator to determine the estimated size required for your statistics configuration. The value appears in the **Estimated space required** field after you enter values.

4 Click **OK**.

Statistics Collection for Microsoft Windows Guest Operating Systems

In a virtualized environment, physical resources are shared among multiple virtual machines.

Some virtualization processes dynamically allocate available resources depending on the status, or utilization rates, of virtual machines in the environment. This can make obtaining accurate information about the resource utilization (CPU utilization, in particular) of individual virtual machines, or applications running within virtual machines, difficult. VMware now provides virtual machine-specific performance counter libraries for the Windows Performance utility. Application administrators can view accurate virtual machine resource utilization statistics from within the guest operating system's Windows Performance utility.

Enable Statistics Collection for Guest Operating System Performance Analysis

VMware-specific performance objects are automatically loaded into Microsoft Windows Perfmon and enabled when VMware Tools is installed. To display a performance chart for any performance object, you must add counters.

View Performance Statistics for Windows Guest Operating Systems

You can display VMware-specific statistics using the Microsoft Windows Perfmon utility.

Prerequisites

A virtual machine with a Microsoft Windows operating system and VMware Tools installed.

Procedure

1 Open a console to the virtual machine and log in.

2 Select **Start > Run**.

3 Enter **Perfmon** and press **Enter**.

4 In the Performance dialog box, click the **Add** button or press **Ctrl+I**.

5 In the Add Counters dialog box, select **Use local computer counters**.

6 Select a virtual machine (virtual machine performance object names begin with **VM**) performance object.

7 Select the counters that you would like to display for that object.

8 If the performance object has multiple instances, select the instances you would like to display.

9 Click **Add**.

The Performance dialog box displays data for the selected performance object.

10 Click **Close** to close the Add Counter dialog box and return to the Performance dialog box.

vCenter Server Performance Charts

The performance charts graphically display CPU, memory, disk, network, and storage metrics for devices and entities managed by vCenter Server. Chart types include line charts, pie charts, bar charts, and stacked charts.

You view the performance charts for an object that is selected in the inventory on the vSphere Client **Performance** tab. You can view overview charts and advanced charts for an object. Both the overview charts and the advanced charts use the following chart types to display statistics:

Line charts Display metrics for a single inventory object. The data for each performance counter is plotted on a separate line in the chart. For example, a network chart for a host can contain two lines: one showing the number of packets received, and one showing the number of packets transmitted.

Bar charts Display storage metrics for datastores in a selected datacenter. Each datastore is represented as a bar in the chart, and each bar displays metrics based on file type (virtual disks, snapshots, swap files, and other files).

Pie charts Display storage metrics for a single datastore or virtual machine. Storage information is based on file type or virtual machine. For example, a pie chart for a datastore displays the amount of storage space occupied by the five-largest virtual machines on that datastore. A pie chart for a virtual machine displays the amount of storage space occupied by virtual machine files.

Stacked charts Display metrics for children of the selected parent object. For example, a host's stacked CPU usage chart displays CPU usage metrics for each virtual machine on the host. The metrics for the host itself are displayed in separate line charts. Stacked charts are useful in comparing resource allocation and usage across multiple hosts or virtual machines. Each metric group appears on a separate chart for a managed entity. For example, hosts have one chart that displays CPU metrics and one that displays memory metrics.

Overview Performance Charts

The overview performance charts enable you to view CPU, memory, network, disk, and storage metrics for an object at the same time.

All overview charts for an object appear in the same panel in the **Performance** tab. This allows you to do side-by-side comparisions of resource usage for clusters, datacenters, datastores, hosts, resource pools, and virtual machines. You can perform the following tasks with the overview performance charts.

- View all charts for an object in one panel. The single-panel view enables you to make side-by-side comparisons of different resource statistics, for example, CPU usage and memory usage.

- View real-time and historic data.
- View thumbnail charts for child objects. Thumbnail charts provide a quick summary of resource usage for each child object of a datacenter, datastore, cluster, or host.
- Open the overview charts for a child object by clicking the object name in the thumbnail section.

View the Overview Performance Charts

You can view CPU, memory, disk, network, and storage statistics for an object in the overview performance charts. These charts support a subset of data counters supported by vCenter Server.

Prerequisites

The vSphere Client must be connected to a vCenter Server system.

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Performance** tab.

3 Click **Overview**.

The overview charts for the object appear.

View the Overview Performance Charts Help

The Performance Chart Help contains information on how to work with overview charts, including how to analyze chart data and how to set the time range for the chart data. It also describes the metric counters displayed in each overview chart.

Procedure

1 Display the object in the inventory panel.

2 Select the object and click the **Performance** tab.

3 Click **Overview**.

4 Click the Help icon (**?**).

5 To view the Help for a specific chart, click the Help icon for that chart.

Advanced Performance Charts

With the advanced performance charts, you can see data point information for a plotted metric, export chart data to a spreadsheet, and save chart data to a file. You can customize the advanced chart views.

NOTE You cannot view datastore metrics in the advanced charts. They are only available in the overview charts.

View the Advanced Performance Charts

You can view CPU, memory, disk, and network statistics for an object in the advanced performance charts. These charts support additional data counters not supported in the overview performance charts.

Prerequisites

When connected directly to an ESX/ESXi host, the advanced performance charts display only real-time statistics and past day statistics. To view historical data, the vSphere Client must be connected to a vCenter Server system.

Procedure

1 Select a host, cluster, resource pool, or virtual machine in the inventory panel.

2 Click the **Performance** tab.

3 Click **Advanced**.

4 To view a different chart, select an option from the **Switch to** list.

The default charts are configured to show the following information.

Option	Description
CPU	Shows the CPU usage in MHz. Available for clusters, resource pools, hosts, and virtual machines.
Memory	Shows the amount of memory granted. Available for clusters, resource pools, hosts, and virtual machines.
Disk	Shows the aggregated storage performance statistics. Available for hosts and virtual machines.
Network	Shows the aggregated network performance statistics. Available for hosts and virtual machines.
System	Shows statistics for overall system availability, including CPU usage by the service console and other aapplications. Available for hosts and virtual machines.
Cluster Services	Shows aggregate CPU, aggregate memory, and failover statistics for DRS and HA clusters and hosts that are part of DRS clusters.

The amount of historical data displayed in a chart depends on the collection interval and collection level set for vCenter Server.

Save Chart Data to a File

You can save data from the Advanced performance charts to a file in various graphics formats or in Microsoft Excel format.

Procedure

1 In the **Performance** tab, click **Advanced**.

2 Click **Save**.

3 In the Save Performance Chart dialog box, navigate to the location to save the file.

4 Enter a name for the file.

5 Select a file type.

6 Click **Save**.

The file is saved to the location and format you specified.

Export Performance Data to a Spreadsheet

You can export performance data from the Advanced charts to a Microsoft Office Excel file. You use the vSphere Client to export data.

Prerequisites

Before you view or export performance data, verify that the time is set correctly on the ESX/ESXi host, the vCenter Server system, and the client machine. Each host and client machine can be in different time zones, but the times must be correct for their respective time zones.

Procedure

1 Display the object in the inventory.

2 Select **File > Report > Performance**.

If performance data is not available for the selected inventory object, the Export Performance option is not available.

3 Enter a filename and location.

4 Select the date and time range for the chart.

5 In **Chart Options**, select the chart type.

6 Select the metric groups to display in the chart.

You can also specify the objects using the **All** or **None** buttons.

7 (Optional) To customize the options, click **Advanced**, select the objects and counters to include in the chart, and click **OK**.

8 Specify the size of the chart in the exported file.

9 Click **OK** to export the data.

Customize Advanced Chart Views

You can customize a performance chart by specifying the objects to monitor, the counters to include, the time range, and chart type. You can customize preconfigured chart views and create new chart views.

Changes to chart options take effect immediately. New views are added to the **Switch to** menu.

Procedure

1 Display the object in the inventory.

2 Select the object and click the **Performance** tab.

3 Click **Advanced**.

4 Click **Chart Options**.

5 In Chart Options, select a metric group for the chart.

6 Select a time range for the metric group.

If you choose **Custom**, do one of the following.

- Select **Last** and set the number of hours, days, weeks, or months for the amount of time to monitor the object.
- Select **From** and select the beginning and end dates.

You can also customize the time range options by customizing the statistics collection interval setting.

7 Select the chart type.

When selecting the stacked graph option, consider the following.

- You can select only one item from the list of measurements.
- Per-virtual-machine stacked graphs are available only for hosts.
- Click a counter description name to display information about the counter's function and whether the selected metric can be stacked for per-virtual-machine graphs.

8 In Objects, select the inventory objects to display in the chart.

You can also specify the objects using the **All** or **None** buttons.

9 In Counters, select the data counters to display in the chart.

You can also specify counters using the **All** or **None** buttons.

Click a counter name to display information about the counter in the Counter Description panel.

10 Click **Apply** to see the results.

11 Click **OK**.

To view the chart in its own window, click the pop-up chart button (). This enables you to view additional charts while keeping this chart open.

Delete a Custom Advanced Chart View

You can delete custom chart views from the vSphere Client.

Procedure

1 Display the vSphere Client inventory panel.

2 Select any object in the datacenter to enable the **Performance** tab.

3 Click the **Performance** tab and click **Advanced**.

4 Click **Chart Options** to open the Customize Performance Charts dialog box.

5 Click **Manage Chart Settings**.

6 Select a chart and click **Delete**.

The chart is deleted, and it is removed from the **Switch to** menu.

7 Click **OK**.

Monitoring and Troubleshooting Performance

You monitor CPU, memory, disk, network, and storage metrics by using the performance charts located on the **Performance** tab of the vSphere Client. Use the following guidelines to identify and resolve potential performance problems.

- CPU Performance on page 280

  Use the vSphere Client CPU performance charts to monitor CPU usage for hosts, clusters, resource pools, virtual machines, and vApps. Use the guidelines below to identify and correct problems with CPU performance.

- Disk I/O Performance on page 280

  Use the vSphere Client disk performance charts to monitor disk I/O usage for clusters, hosts, and virtual machines. Use the guidelines below to identify and correct problems with disk I/O performance.

- Memory Performance on page 281

  Use the vSphere Client memory performance charts to monitor memory usage of clusters, hosts, virtual machines, and vApps. Use the guidelines below to identify and correct problems with memory performance.

- Network Performance on page 282

  Use the network performance charts to monitor network usage and bandwidth for clusters, hosts, and virtual machines. Use the guidelines below to identify and correct problems with networking performance.

- Storage Performance on page 283

  Use the vSphere Client datastore performance charts to monitor datastore usage. Use the guidelines below to identify and correct problems with datastore performance.

CPU Performance

Use the vSphere Client CPU performance charts to monitor CPU usage for hosts, clusters, resource pools, virtual machines, and vApps. Use the guidelines below to identify and correct problems with CPU performance.

A short spike in CPU usage or CPU ready indicates that you are making the best use of the host resources. However, if both values are constantly high, the hosts are probably overcommitted. Generally, if the CPU usage value for a virtual machine is above 90% and the CPU ready value is above 20%, performance is impacted.

Table 22-6. CPU Performance Enhancement Advice

#	Resolution
1	Verify that VMware Tools is installed on every virtual machine on the host.
2	Compare the CPU usage value of a virtual machine with the CPU usage of other virtual machines on the host or in the resource pool. The stacked bar chart on the host's Virtual Machine view shows the CPU usage for all virtual machines on the host.
3	Determine whether the high ready time for the virtual machine resulted from its CPU usage time reaching the CPU limit setting. If so, increase the CPU limit on the virtual machine.
4	Increase the CPU shares to give the virtual machine more opportunities to run. The total ready time on the host might remain at the same level if the host system is constrained by CPU. If the host ready time doesn't decrease, set the CPU reservations for high-priority virtual machines to guarantee that they receive the required CPU cycles.
5	Increase the amount of memory allocated to the virtual machine. This decreases disk and or network activity for applications that cache. This might lower disk I/O and reduce the need for the ESX/ESXi host to virtualize the hardware. Virtual machines with smaller resource allocations generally accumulate more CPU ready time.
6	Reduce the number of virtual CPUs on a virtual machine to only the number required to execute the workload. For example, a single-threaded application on a four-way virtual machine only benefits from a single vCPU. But the hypervisor's maintenance of the three idle vCPUs takes CPU cycles that could be used for other work.
7	If the host is not already in a DRS cluster, add it to one. If the host is in a DRS cluster, increase the number of hosts and migrate one or more virtual machines onto the new host.
8	Upgrade the physical CPUs or cores on the host if necessary.
9	Use the newest version of ESX/ESXi, and enable CPU-saving features such as TCP Segmentation Offload, large memory pages, and jumbo frames.

Disk I/O Performance

Use the vSphere Client disk performance charts to monitor disk I/O usage for clusters, hosts, and virtual machines. Use the guidelines below to identify and correct problems with disk I/O performance.

The virtual machine disk usage (%) and I/O data counters provide information about average disk usage on a virtual machine. Use these counters to monitor trends in disk usage.

The best ways to determine if your vSphere environment is experiencing disk problems is to monitor the disk latency data counters. You use the Advanced performance charts to view these statistics.

- The kernelLatency data counter measures the average amount of time, in milliseconds, that the VMkernel spends processing each SCSI command. For best performance, the value should be 0-1 milliseconds. If the value is greater than 4ms, the virtual machines on the ESX/ESXi host are trying to send more throughput to the storage system than the configuration supports. Check the CPU usage, and increase the queue depth or storage.
- The deviceLatency data counter measures the average amount of time, in milliseconds, to complete a SCSI command from the physical device. Depending on your hardware, a number greater than 15ms indicates there are probably problems with the storage array. Move the active VMDK to a volume with more spindles or add disks to the LUN.

- The queueLatency data counter measures the average amount of time taken per SCSI command in the VMkernel queue. This value must always be zero. If not, the workload is too high and the array cannot process the data fast enough.

Table 22-7. Disk I/O Performance Enhancement Advice

#	Resolution
1	Increase the virtual machine memory. This should allow for more operating system caching, which can reduce I/O activity. Note that this may require you to also increase the host memory. Increasing memory might reduce the need to store data because databases can utilize system memory to cache data and avoid disk access. To verify that virtual machines have adequate memory, check swap statistics in the guest operating system. Increase the guest memory, but not to an extent that leads to excessive host memory swapping. Install VMware Tools so that memory ballooning can occur.
2	Defragment the file systems on all guests.
3	Disable antivirus on-demand scans on the VMDK and VMEM files.
4	Use the vendor's array tools to determine the array performance statistics. When too many servers simultaneously access common elements on an array, the disks might have trouble keeping up. Consider array-side improvements to increase throughput.
5	Use Storage VMotion to migrate I/O-intensive virtual machines across multiple ESX/ESXi hosts.
6	Balance the disk load across all physical resources available. Spread heavily used storage across LUNs that are accessed by different adapters. Use separate queues for each adapter to improve disk efficiency.
7	Configure the HBAs and RAID controllers for optimal use. Verify that the queue depths and cache settings on the RAID controllers are adequate. If not, increase the number of outstanding disk requests for the virtual machine by adjusting the `Disk.SchedNumReqOutstanding` parameter. For more information, see the *Fibre Channel SAN Configuration Guide*.
8	For resource-intensive virtual machines, separate the virtual machine's physical disk drive from the drive with the system page file. This alleviates disk spindle contention during periods of high use.
9	On systems with sizable RAM, disable memory trimming by adding the line `MemTrimRate=0` to the virtual machine's .VMX file.
10	If the combined disk I/O is higher than a single HBA capacity, use multipathing or multiple links.
11	For ESXi hosts, create virtual disks as preallocated. When you create a virtual disk for a guest operating system, select **Allocate all disk space now**. The performance degradation associated with reassigning additional disk space does not occur, and the disk is less likely to become fragmented.
12	Use the most current ESX/ESXi host hardware.

Memory Performance

Use the vSphere Client memory performance charts to monitor memory usage of clusters, hosts, virtual machines, and vApps. Use the guidelines below to identify and correct problems with memory performance.

To ensure best performance, the host memory must be large enough to accommodate the active memory of the virtual machines. Note that the active memory can be smaller than the virtual machine memory size. This allows you to over-provision memory, but still ensures that the virtual machine active memory is smaller than the host memory.

A virtual machine's memory size must be slightly larger than the average guest memory usage. This enables the host to accommodate workload spikes without swapping memory among guests. Increasing the virtual machine memory size results in more overhead memory usage.

If a virtual machine has high ballooning or swapping, check the amount of free physical memory on the host. A free memory value of 6% or less indicates that the host cannot meet the memory requirements. This leads to memory reclamation which may degrade performance. If the active memory size is the same as the granted memory size, demand for memory is greater than the memory resources available. If the active memory is consistently low, the memory size might be too large.

If the host has enough free memory, check the resource shares, reservation, and limit settings of the virtual machines and resource pools on the host. Verify that the host settings are adequate and not lower than those set for the virtual machines.

If the memory usage value is high, and the host has high ballooning or swapping, check the amount of free physical memory on the host. A free memory value of 6% or less indicates that the host cannot handle the demand for memory. This leads to memory reclamation which may degrade performance.

If memory usage is high or you notice degredation in performance, consider taking the actions listed below.

Table 22-8. Memory Performance Enhancement Advice

#	Resolution
1	Verify that VMware Tools is installed on each virtual machine. The balloon driver is installed with VMware Tools and is critical to performance.
2	Verify that the balloon driver is enabled. The VMkernel regularly reclaims unused virtual machine memory by ballooning and swapping. Generally, this does not impact virtual machine performance.
3	Reduce the memory space on the virtual machine, and correct the cache size if it is too large. This frees up memory for other virtual machines.
4	If the memory reservation of the virtual machine is set to a value much higher than its active memory, decrease the reservation setting so that the VMkernel can reclaim the idle memory for other virtual machines on the host.
5	Migrate one or more virtual machines to a host in a DRS cluster.
6	Add physical memory to the host.

Network Performance

Use the network performance charts to monitor network usage and bandwidth for clusters, hosts, and virtual machines. Use the guidelines below to identify and correct problems with networking performance.

Network performance is dependent on application workload and network configuration. Dropped network packets indicate a bottleneck in the network. To determine whether packets are being dropped, use `esxtop` or the advanced performance charts to examine the `droppedTx` and `droppedRx` network counter values.

If packets are being dropped, adjust the virtual machine shares. If packets are not being dropped, check the size of the network packets and the data receive and transfer rates. In general, the larger the network packets, the faster the network speed. When the packet size is large, fewer packets are transferred, which reduces the amount of CPU required to process the data. When network packets are small, more packets are transferred but the network speed is slower because more CPU is required to process the data.

NOTE In some instances, large packets can result in high network latency. To check network latency, use the VMware AppSpeed performance monitoring application or a third-party application.

If packets are not being dropped and the data receive rate is slow, the host is probably lacking the CPU resources required to handle the load. Check the number of virtual machines assigned to each physical NIC. If necessary, perform load balancing by moving virtual machines to different vSwitches or by adding more NICs to the host. You can also move virtual machines to another host or increase the host CPU or virtual machine CPU.

Table 22-9. Networking Performance Enhancement Advice

#	Resolution
1	Verify that VMware Tools is installed on each virtual machine.
2	If possible, use vmxnet3 NIC drivers, which are available with VMware Tools. They are optimized for high performance.
3	If virtual machines running on the same ESX/ESXi host communicate with each other, connect them to the same vSwitch to avoid the cost of transferring packets over the physical network.
4	Assign each physical NIC to a port group and a vSwitch.

Table 22-9. Networking Performance Enhancement Advice (Continued)

#	Resolution
5	Use separate physical NICs to handle the different traffic streams, such as network packets generated by virtual machines, iSCSI protocols, VMotion tasks, and service console activities.
6	Ensure that the physical NIC capacity is large enough to handle the network traffic on that vSwitch. If the capacity is not enough, consider using a high-bandwidth physical NIC (10Gbps) or moving some virtual machines to a vSwitch with a lighter load or to a new vSwitch.
7	If packets are being dropped at the vSwitch port, increase the virtual network driver ring buffers where applicable.
8	Verify that the reported speed and duplex settings for the physical NIC match the hardware expectations and that the hardware is configured to run at its maximum capability. For example, verify that NICs with 1Gbps are not reset to 100Mbps because they are connected to an older switch.
9	Verify that all NICs are running in full duplex mode. Hardware connectivity issues might result in a NIC resetting itself to a lower speed or half duplex mode.
10	Use vNICs that are TSO-capable, and verify that TSO-Jumbo Frames are enabled where possible.

Storage Performance

Use the vSphere Client datastore performance charts to monitor datastore usage. Use the guidelines below to identify and correct problems with datastore performance.

NOTE The datastore charts are available only in the overview performance charts.

The datastore is at full capacity when the used space is equal to the capacity. Allocated space can be larger than datastore capacity, for example, when you have snapshots and thin-provisioned disks. You can provision more space to the datastore if possible, or you can add disks to the datastore or use shared datastores.

If snapshot files are consuming a lot of datastore space, consider consolidating them to the virtual disk when they are no longer needed. Consolidating the snapshots deletes the redo log files and removes the snapshots from the vSphere Client user interface. For information on consolidating the datacenter, see the *vSphere Client Help*.

Working with Tasks and Events 23

The topics in this section describe vSphere tasks and events and provide information on how to work with them.

This chapter includes the following topics:

- "Managing Tasks," on page 285
- "Managing Events," on page 291

Managing Tasks

Tasks represent system activities that do not complete immediately, such as migrating a virtual machine. They are initiated by high-level activities you perform with the vSphere Client in real-time and those you schedule to occur at a later time or on a recurring basis.

For example, powering off a virtual machine is a task. You can perform this task manually every evening, or you can set up a scheduled task to power off the virtual machine every evening for you.

NOTE The functionality available in the vSphere Client depends on whether the vSphere Client is connected to a vCenter Server system or an ESX/ESXi host. Unless indicated, the process, task, or description applies to both kinds of vSphere Client connections. When the vSphere Client is connected to an ESX/ESXi host, the **Tasks** option is not available; however, you can view recent tasks in the **Status Bar** at the bottom of the vSphere Client.

Viewing Tasks

You can view tasks that are associated with a single object or all objects in the vSphere Client inventory. The **Tasks & Events** tab lists completed tasks and tasks that are currently running.

By default, the tasks list for an object also includes tasks performed on its child objects. You can filter the list by removing tasks performed on child objects and by using keywords to search for tasks.

If you are logged in to a vCenter Server system that is part of a Connected Group, a column in the task list displays the name of the vCenter Server system on which the task was performed.

View All Tasks

You view completed tasks and running tasks on the vSphere Client **Tasks & Events** tab.

Procedure

1 Display the object in the inventory.

2 Display the tasks for a single object or the entire vCenter Server.
   - To display the tasks for an object, select the object.
   - To display the tasks in the vCenter Server, select the root folder.
3 Click the **Tasks & Events** tab.

   The task list contains tasks performed on the object and its children.
4 (Optional) To view detailed information for a task, select the task in the list.

   Details appear in the **Task Details** pane.

View Recent Tasks

You view recent tasks for vCenter Server or an ESX/ESXi host in the vSphere Client **Recent Tasks** pane.

Procedure

1 Display the Inventory panel.
2 Select the object.
3 If necessary, select **View > Status** to display the status bar at the bottom of the vSphere Client.
4 In the status bar, Click **Tasks**.

   The list of completed tasks appears in the **Recent Tasks** pane of the **Status Bar**.

View Scheduled Tasks

You view scheduled tasks in the vSphere Client **Scheduled Tasks** pane. The scheduled task list includes tasks that are scheduled to run and those that have already run.

Procedure

- In the navigation bar, select **Home > Management > Scheduled Tasks**.

Filter Tasks for a Host or Datacenter

Filtering the task list removes tasks performed on child objects.

Procedure

1 Select the host or datacenter in the inventory and click the **Tasks & Events** tab.
2 In **View**, click **Tasks** to display the tasks list.
3 If the **Show all entries** list and the search field are not displayed under the **Tasks** and **Events** buttons, select **View > Filtering**.
4 Click **Show all entries** and select **Show host entries** or **Show datacenter entries**, depending on the object selected.

Use Keywords to Filter the Tasks List

You can filter the tasks list based on any task attribute, including task name, target, status, initiator, change history, and time. Filtering is inclusive, not exclusive. If the keyword is found in any of the selected columns, the task is included in the filtered list.

Procedure

1 Display the object in the inventory.
2 Select the object and click the **Tasks & Events** tab.

3 If the **Name, Target or Status contains** search field is not displayed, select **View > Filtering**.

4 Click the search field arrow and select the attributes to include in the search.

5 Type a keyword into the box and press Enter.

Cancel a Task

Canceling a task stops a running task from occurring. Canceling a scheduled task does not cancel subsequent runs. To cancel a scheduled task that has not run, reschedule it.

NOTE You can only cancel a subset of tasks by using the vSphere Client, and you cannot cancel tasks on an ESX Server version 2.0.1 host.

Required privileges:

- Manual tasks: **Tasks.Update Task**
- Scheduled tasks:**Scheduled Task.Remove Task**
- Appropriate permissions on the host where the task is running

Prerequisites

To cancel a task, the vSphere Client must be connected to a vCenter Server system.

Procedure

1 Locate the task in the **Recent Tasks** pane of the **Status Bar**.

By default, the **Status Bar**is displayed at the bottom of the vSphere Client. If it is not visible, select **View > Status Bar**.

2 Right-click the appropriate task and select **Cancel**.

If the cancel option is unavailable, the selected task cannot be canceled.

The vCenter Server system or ESX/ESXi host stops the progress of the task and returns the object to its previous state. The vSphere Client displays the task with a **Canceled** status.

Schedule Tasks

You can schedule tasks to run once in the future or multiple times, at a recurring interval.

The vSphere Client must be connected to a vCenter Server system to create and manage scheduled tasks. The tasks you can schedule are listed in the following table.

Table 23-1. Scheduled Tasks

Scheduled Task	Description
Add a host	Adds the host to the specified datacenter or cluster.
Change the power state of a virtual machine	Powers on, powers off, suspends, or resets the state of the virtual machine.
Change resource settings of a resource pool or virtual machine	Changes the following resource settings: ■ CPU – Shares, Reservation, Limit. ■ Memory – Shares, Reservation, Limit.
Check compliance of a profile	Checks that a host's configuration matches the configuration specified in a host profile.
Clone a virtual machine	Makes a clone of the virtual machine and places it on the specified host or cluster.
Create a virtual machine	Creates a new virtual machine on the specified host.

Table 23-1. Scheduled Tasks (Continued)

Scheduled Task	Description
Deploy a virtual machine	Creates a new virtual machine from a template on the specified host or cluster.
Export a virtual machine	Exports virtual machines that vCenter Server manages to managed formats or hosted formats. The export process converts the source to a virtual machine in the format you specify. This scheduled task is available only when VMware vCenter Converter is installed.
Import a virtual machine	Imports a physical machine, virtual machine, or system image into a virtual machine that vCenter Server manages. This scheduled task is available only when VMware vCenter Converter is installed.
Migrate a virtual machine	Migrate a virtual machine to the specified host or datastore by using migration or migration with VMotion.
Make a snapshot of a virtual machine	Captures the entire state of the virtual machine at the time the snapshot is taken.
Scan for Updates	Scans templates, virtual machines, and hosts for available updates. This task is available only when VMware vCenter Update Manager is installed.
Remediate	Downloads any new patches discovered during the scan operation and applies the newly configured settings. This task is available only when VMware vCenter Update Manager is installed.

You create scheduled tasks by using the Scheduled Task wizard. For some scheduled tasks, this wizard opens the wizard used specifically for that task. For example, if you create a scheduled task that migrates a virtual machine, the Scheduled Task wizard opens the Migrate Virtual Machine wizard, which you use to set up the migration details.

Scheduling one task to run on multiple objects is not possible. For example, you cannot create one scheduled task on a host that powers on all virtual machines on that host. You must create a separate scheduled task for each virtual machine.

After a scheduled task runs, you can reschedule it to run again at another time.

Create a Scheduled Task

To schedule a task, use the Scheduled Task wizard.

Required privilege: **Schedule Task.Create Tasks**

You can schedule a limited number of tasks by using the vSphere Client. If the task to schedule is not available, use the VMware Infrastructure API. See the vSphere SDK *Programming Guide*.

CAUTION Do not schedule multiple tasks to be performed at the same time on the same object. The results are unpredictable.

Prerequisites

The vSphere Client must be connected to a vCenter Server system to schedule tasks.

Procedure

1 In the navigation bar, click **Home > Management > Scheduled Tasks**.

The current list of scheduled tasks appears.

2 In the toolbar, click **New**.

3 In the Select a Task to Schedule dialog box, select a task and click **OK** to open the wizard for that task.

NOTE For some scheduled tasks, the wizard opens the wizard used specifically for that task. For example, to migrate a virtual machine, the Scheduled Task wizard opens the Migrate Virtual Machine Wizard, which you use to set up the migration details.

4 Complete the wizard that opens for the task.

5 Click **OK** to open the Scheduled Task wizard.

6 Enter a task name and task description and click **Next**.

7 Select a **Frequency** and specify a **Start Time**.

You can schedule a task to run only once during a day. To set up a task to run multiple times in one day, set up additional scheduled tasks.

Option	Action
Once	■ To run the scheduled task immediately, select **Now** and click **Next**. ■ To run the scheduled task at a later time and date, select **Later** and enter a **Time**. Click the **Date** arrow to display the calendar and click a date.
After Startup	In **Delay**, enter the number of minutes to delay the task.
Hourly	a In **Start Time**, enter the number of minutes after the hour to run the task. b In **Interval**, enter the number of hours after which to run the task. For example, to start a task at the half-hour mark of every 5th hour, enter **`30`** and **`5`**.
Daily	■ Enter the **Start Time** and **Interval**. For example, to run the task at 2:30 pm every four days, enter **`2:30`** and **`4`**.
Weekly	a Enter the **Interval** and **Start Time**. b Select each day on which to run the task. For example, to run the task at 6 am every Tuesday and Thursday, enter **`1`** and **`6 am`**, and select **Tuesday** and **Thursday**.
Monthly	a Enter the **Start Time**. b Specify the days by using one of the following methods. ■ Enter a specific date of the month. ■ Select **first**, **second**, **third**, **fourth**, or **last,** and select the day of the week. **last** runs the task on the last week in the month that the day occurs. For example, if you select the last Monday of the month and the month ends on a Sunday, the task runs six days before the end of the month. c In **Interval**, enter the number of months between each task run.

8 Click **Next**.

9 Set up email notifications and click **Next**.

10 Click **Finish**.

The vCenter Server system adds the task to the list in the **Scheduled Tasks** window.

Canceling Scheduled Tasks

Canceling a task stops a running task from occurring, regardless of whether the task was a real-time task or a scheduled task. The operation cancels only the running task. If the task being canceled is a scheduled task, subsequent runs are not canceled.

Tasks that aren't running can be cleared when they are in a queued or scheduled state. In such cases, because the cancel operation is not available, either remove the task or reschedule it to run at a different time. Removing a scheduled task requires that you recreate it to run it in the future, rescheduling does not.

You can cancel the following tasks:

- Connecting to a host
- Cloning a virtual machine
- Deploying a virtual machine
- Migrating a powered off virtual machine. This task is cancelable only when the source disks have not been deleted.

If your vSphere uses virtual services, you can also cancel the following scheduled tasks:

- Change the power state of a virtual machine
- Make a snapshot of a virtual machine

Change or Reschedule a Task

After a scheduled task is created, you can change the timing, frequency, and specifics of the task. You can edit and reschedule tasks before or after they run.

Required privilege:**Schedule Task.Modify Task**

Procedure

1 In the vSphere Client navigation bar, click **Home > Management > Scheduled Tasks**.

2 Select the task.

3 In the toolbar, click **Properties**.

4 Change task attributes as necessary.

5 Click **Next** to advance through the wizard.

6 Click **Finish**.

Remove a Scheduled Task

Removing a scheduled task removes all future occurrences of the task. The history associated with all completed occurrences of the task remains in the vCenter Server database.

Prerequisites

To remove scheduled tasks, the vSphere Client must be connected to the vCenter Server system.

Required privilege:**Scheduled Task.Remove Task**

Procedure

1 In the vSphere Client navigation bar, click **Home > Management > Scheduled Tasks**.

2 Select the task.

3 Select **Inventory > Scheduled Task > Remove**.

4 Click **OK**.

The task is removed from the list of scheduled tasks.

Policy Rules for Task Operations

The vCenter Server and ESX/ESXi hosts adhere to certain rules when managing tasks in the system.

vCenter Server and ESX/ESXi hosts use the following rules to process tasks:

- The user performing the task in the vSphere Client must have the correct permissions on the relevant objects. After a scheduled task is created, it will be performed even if the user no longer has permission to perform the task.
- When the operations required by manual tasks and scheduled tasks conflict, the activity due first is started first.
- When a virtual machine or host is in an incorrect state to perform any activity, manual or scheduled, vCenter Server or the ESX/ESXi host does not perform the task. A message is recorded in the log.
- When an object is removed from the vCenter Server or the ESX/ESXi host, all associated tasks are also removed.
- The vSphere Client and vCenter Server system use UTC time to determine the start time of a scheduled task. This ensures vSphere Client users in different time zones see the task scheduled to run at their local time.

Events are logged in the event log at start and completion of a task. Any errors that occur during a task are also recorded in the event log.

CAUTION Do not schedule multiple tasks to be performed at the same time on the same object. The results are unpredictable.

Managing Events

An event is an action that occurs on an object in vCenter Server or on a host.

Events include user actions and system actions that occur on managed objects in the vSphere Client inventory. For example, events are created when a user logs in to a virtual machine and when a host connection is lost.

Each event records an event message. An event message is a predefined description of an event. Event messages contain information such as the user who generated the event, the time the event occurred, and the type of event message (information, error, or warning). Event messages are archived in vCenter Server.

Typically, event details include the name of the object on which the event occurred and describes the action that occurred. The object of the event is a link to the object's individual event page.

NOTE When actions occur on a folder, for example, when an alarm is created on a folder, the related event (in this case the AlarmCreatedEvent) is visible only in the parent datacenter.

Viewing Events

You can view events associated with a single object or with all objects in the vSphere Client inventory.

The events listed for a selected object include events associated with the child objects. Detailed information about a selected event appears in the Event Details panel below the event list.

NOTE When the vSphere Client is connected directly to an ESX/ESXi host, the **Tasks & Events** tab is labeled **Events**.

View Events Associated with One Object

The events listed for a selected object include events associated with its child objects.

Required privilege: **Read-only**

Procedure

1 Display the object in the vSphere Client inventory.

2 Select the object and click the **Tasks & Events** tab.

3 Click **Events**.

A list of events appears.

4 (Optional) Select an event in the list to see the **Event Details**, including a list of related events.

View Events Associated with All Objects

The most recent events appear at the top of the Events list. Events are identified by Information type, Error type, and Warning type.

Required privilege: **Read-only**

Procedure

1 View the events associated with all objects in the inventory.

- In the navigation bar, click **Home > Management > Events**.
- In the inventory, select the root node, click the **Tasks & Events** tab, and click **Events**.

2 (Optional) To see details about an event in the list, select the event.

The **Event Details** panel shows the details.

3 (Optional) To see events related to a target object in the list, click the target object's name.

The **Tasks & Events** tab for the selected object appears.

Filter Events on a Host or Datacenter

By default, the events list for an object includes events performed on its child objects. You can remove all child events associated with a host or a datastore and display only the events performed on the object itself.

Procedure

1 Display the host or datacenter in the inventory.

2 Select the host or datacenter and click the **Tasks & Events** tab.

3 Click **Events** to display the events list.

4 If the **Show all entries** list and search field are not visible under the **Tasks** and **Events** buttons, select **View > Filtering**.

5 Click **Show all entries** and select **Show host entries** or **Show datacenter entries**, depending on the object selected.

Use Keywords to Filter the Events List

You can display events based on any attribute, including event name, target, type, user, change history, and time. Filtering is inclusive, not exclusive. If the keyword is found in any of the selected columns, the event is included in the list.

Procedure

1 Select the object on which to filter the events.

- To filter events associated with one object, select the object in the inventory, click the **Events** tab, and click **Events**.
- To filter events associated with all objects, in the navigation bar, click **Home > Management > Events**.

2 If the **Name, Target or Status contains** search field is not visible, select **View > Filtering**.

The search field appears.

3 Click the search field arrow and select the attributes to include in the search.

4 Type a keyword in the field and press Enter.

The events that match the search are retrieved and displayed in the events list.

Trigger an Alarm on an Event

You can configure an alarm to trigger when an event occurs in the vCenter Server System.

Procedure

1 In the inventory, select the object on which to create the alarm.

For example, to create an alarm for all hosts in a cluster, display the cluster. To create an alarm for a single host, display the host.

2 Select **File > New > Alarm**.

3 Complete the information on the **General** tab.

a Enter an alarm name and description.

b In **Alarm Type**, select the object to monitor and select **Monitor for specific events occurring on this object**.

4 Click the **Triggers** tab and set up the alarm triggers.

5 Click to the **Actions** tab and set up the alarm actions.

The vCenter Server verifies the configuration of the alarm and adds the alarm to the list of alarms for the selected object.

For help on configuring the values on each tab, click **Help**.

Export Events

You can export all or part of the events log file when the vSphere Client is connected to a vCenter Server system.

Required Privilege: **Read-only**

Procedure

1 Select **File > Export > Export Events**.

2 If your vSphere environment has multiple vCenter Servers, in the**vCenter Server** list, select the server where the events occurred.

3 In **File name**, type a name for the event file.

NOTE If you do not specify a file extension, the file is saved as a text file.

4 In **Events**, specify the event attributes on which to filter.

a In **Type**, select **User** or **System**.

b If you selected **User**, select a user option.

- **All users**
- **These users**
- To specify a subset of users, click **Search** and specify the users to include.

c In **Severity**, select the event level: **Error**, **Info**, or **Warning**.

5 In **Time**, specify the time range during which the events to export occurred.

- To specify an hour, day, week, or month time period, select **Last** and set the number and time increment.
- To specify a calendar time span, select **From** and set the from and to dates.

6 In **Limits**, set the number of events to export.

- Select **All matching events**.
- Select **most recent matching events** and enter the number.

7 Click **OK**.

vCenter Server creates the file in the specified location. The file contains the **Type**, **Time**, and **Description** of the events.

Appendixes

Defined Privileges

A

The following tables list the default privileges that, when selected for a role, can be paired with a user and assigned to an object. The tables in this appendix use VC to indicate vCenter Server and HC to indicate host client, a standalone ESX/ESXi host.

When setting permissions, verify all the object types are set with appropriate privileges for each particular action. Some operations require access permission at the root folder or parent folder in addition to access to the object being manipulated. Some operations require access or performance permission at a parent folder and a related object.

vCenter Server extensions might define additional privileges not listed here. Refer to the documentation for the extension for more information on those privileges.

This appendix includes the following topics:

- "Alarms," on page 298
- "Datacenter," on page 299
- "Datastore," on page 299
- "Distributed Virtual Port Group," on page 300
- "Distributed Virtual Switch," on page 301
- "Extensions," on page 302
- "Folders," on page 302
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Alarms

Alarms privileges control the ability to set and respond to alarms on inventory objects.

Table A-1. Alarms Privileges

Privilege Name	Description	Used	Pair with Object	Effective on Object
Acknowledge alarm	Suppresses all alarm actions from occurring on all triggered alarms. User interface element – **Triggered Alarms** panel	VC only	All inventory objects	Object on which an alarm is defined
Create alarm	Creates a new alarm. When creating alarms with a custom action, privilege to perform the action is verified when the user creates the alarm. User interface element– **Alarms** tab context menu, **File > New > Alarm**	VC only	All inventory objects	Object on which an alarm is defined
Disable alarm action	Stops the alarm action from occurring after an alarm has been triggered. This does not disable the alarm from triggering. User interface element – **Inventory > object_name > Alarm > Disable All Alarm Actions**	VC only	All inventory objects	Object on which an alarm is defined
Modify alarm	Changes the properties of an existing alarm. User interface element – **Alarms** tab context menu	VC only	All inventory objects	Object on which an alarm is defined
Remove alarm	Deletes an existing alarm. User interface element – **Alarms** tab context menu	VC only	All inventory objects	Object on which an alarm is defined
Set alarm status	Changes the status of the configured event alarm. The status can change to **Normal**, **Warning**, or **Alert**. User interface element – **Alarm Settings**dialog box, **Triggers** tab	VC only	All inventory objects	Object on which an alarm is defined

Datacenter

Datacenter privileges control the ability to create and edit datacenters in the vSphere Client inventory.

Table A-2. Datacenter Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create datacenter	Creates a new datacenter. User interface element– **Inventory** context menu, toolbar button, and **File > New Datacenter**	VC only	Datacenter folders or root object	Datacenter folder or root object
IP pool configuration	Allows configuration of a pool of IP addresses.	VC only	Datacenters, Datacenter folders, or root object	Datacenter
Move datacenter	Moves a datacenter. Privilege must be present at both the source and destination. User interface element – Inventory drag-and-drop	VC only	Datacenters, Datacenter folders, or root object	Datacenter, source and destination
Remove datacenter	Removes a datacenter. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element– **Inventory** context menu, **Inventory > Datacenter > Remove**, **Edit > Remove**	VC only	Datacenters, Datacenter folders, or root object	Datacenter plus parent object
Rename datacenter	Changes the name of a datacenter. User interface element – Inventory object, **Inventory** context menu, **Edit > Rename**, **Inventory > Datacenter > Rename**	VC only	Datacenters, Datacenter folders, or root object	Datacenter

Datastore

Datastore privileges control the ability to browse, manage, and allocate space on datastores.

Table A-3. Datastore Privileges

Privilege Name	Description	Affects	Effective on Object	Pair with Object
Allocate space	Allocates space on a datastore for a virtual machine, snapshot, clone, or virtual disk.	HC and VC	Datastores	Datastores
Browse datastore	Browses files on a datastore. User interface element – Add existing disk, browse for CD-ROM or Floppy media, serial or parallel port files	HC and VC	Datastores	Datastores, Datastore folders
Low level file operations	Carries out read, write, delete, and rename operations in the datastore browser.	HC and VC	Datastores	Datastores
Move datastore	Moves a datastore between folders. Privileges must be present at both the source and destination. User interface element – Inventory drag-and-drop	VC only	Datastore, source and destination	Datastores, Datastore folders

Table A-3. Datastore Privileges (Continued)

Privilege Name	Description	Affects	Effective on Object	Pair with Object
Remove datastore	Removes a datastore. This privilege is deprecated. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element– Inventory datastore context menu, **Inventory > Datastore > Remove**	HC and VC	Datastores	Datastores, Datastore folders
Remove file	Deletes a file in the datastore. This privilege is deprecated. Assign the **Low level file operations** User interface element – Datastore Browser toolbar button and Datastore context menu	HC and VC	Datastores	Datastores
Rename datastore	Renames a datastore. User interface element– Datastore Properties dialog Change button, host Summary tab context menu	HC and VC	Datastores	Datastores

Distributed Virtual Port Group

Distributed virtual port group privileges control the ability to create, delete, and modify distributed virtual port groups.

Table A-4. Distributed Virtual Port Group Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create	Create a distributed virtual port group.	HC and VC	Datacenter, Network folder	vNetwork Distributed Switch
Delete	Delete a distributed virtual port group. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Modify	Modify the configuration of a distributed virtual port group.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Policy operation	Set the policy of a distributed virtual port group.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Scope operation	Set the scope of a distributed virtual port group.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch

Distributed Virtual Switch

Distributed Virtual Switch privileges control the ability to perform tasks related to the management of vNetwork Distributed Switches.

Table A-5. Distributed Virtual Switch Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create	Create a vNetwork Distributed Switch.	HC and VC	Datacenter, Network folder	Datacenter, Network folder
Delete	Remove a vNetwork Distributed Switch. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Host operation	Change the host members of a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Modify	Change the Configuration of a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Move	Move a vNetwork Distributed Switch into another folder.	VC only	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Policy operation	Change the policy of a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Port configuration operation	Change the configuration of a port in a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
Port setting operation	Change the setting of a port in a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch
VSPAN operation	Change the VSPAN configuration of a vNetwork Distributed Switch.	HC and VC	vNetwork Distributed Switch, Network folder, Datacenter	vNetwork Distributed Switch

Extensions

Extensions privileges control the ability to install and manage extensions.

Table A-6. Extension Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Register extension	Registers an extension (plug-in)	VC only	Root vCenter Server	Root vCenter Server
Unregister extension	Unregisters an extension (plug-in)	VC only	Root vCenter Server	Root vCenter Server
Update extension	Updates an extension (plug-in)	VC only	Root vCenter Server	Root vCenter Server

Folders

Folders privileges control the abililty to create and manage folders.

Table A-7. Folder Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create folder	Creates a new folder. User interface element– Taskbar button, **File** menu, context menu	VC only	Folders	Folders
Delete folder	Deletes a folder. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element– **File** menu, context menu	VC only	Folders plus parent object	Folders
Move folder	Moves a folder. Privilege must be present at both the source and destination. User interface element – Inventory drag-and-drop	VC only	Folders, source and destination	Folders
Rename folder	Changes the name of a folder. User interface element – Inventory pane object text field, context menu, **File** menu	VC only	Folders	Folders

Global

Global privileges control a number of global tasks related to tasks, scripts, and extensions.

Table A-8. Global Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Act as vCenter Server	Prepare or initiate a VMotion send operation or a VMotion receive operation. No user vSphere Client interface elements are associated with this privilege.	VC only	Any object	Root vCenter Server
Cancel task	Cancel a running or queued task. User interface element – Recent tasks pane context menu, **Tasks & Events** context menu. Can currently cancel clone and clone to template.	HC and VC	Any object	Inventory object related to the task
Capacity planning	Enable the use of capacity planning for planning consolidation of physical machines to virtual machines. User interface element - **Consolidation** button in toolbar.	VC only	Root vCenter Server	Root vCenter Server
Diagnostics	Get list of diagnostic files, log header, binary files, or diagnostic bundle. User interface element – **File > Export > Export Diagnostic Data**, Admin **System Logs** tab	VC only	Any object	Root vCenter Server
Disable methods	Allows servers for vCenter Server extensions to disable certain operations on objects managed by vCenter Server. No user vSphere Client interface elements are associated with this privilege.	VC only	Any object	Root vCenter Server
Enable methods	Allows servers for vCenter Server extensions to enable certain operations on objects managed by vCenter Server. No user vSphere Client interface elements are associated with this privilege.	VC only	Any object	Root vCenter Server
Global tag	Add or remove global tags.	HC and VC	Any object	Root host or vCenter Server
Health	View the health of vCenter Server components. User interface element – **vCenter Service Status** on the Home page.	VC only	Root vCenter Server	Root vCenter Server
Licenses	See what licenses are installed and add or remove licenses. User interface element – **Licenses** tab, **Configuration > Licensed Features**	HC and VC	Any object	Root host or vCenter Server
Log Event	Log a user-defined event against a particular managed entity. User interface element – Should ask for a reason when shutting down or rebooting a host.	HC and VC	Any object	Any object
Manage Custom Attributes	Add, remove, or rename custom field definitions. User interface element – **Administration > Custom Attributes**	VC only	Any object	Root vCenter Server

Table A-8. Global Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Proxy	Allows access to an internal interface for adding or removing endpoints to or from the proxy. No user vSphere Client interface elements are associated with this privilege.	VC only	Any object	Root vCenter Server
Script Action	Schedule a scripted action in conjunction with an alarm. User interface element – **Alarm Settings** dialog box	VC only	Any object	Any object
Service Managers	Allows use of the resxtop command in the vSphere CLI. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Root host or vCenter Server	Root host or vCenter Server
Set Custom Attributes	View, create, or remove custom attributes for a managed object. User interface element – Any list view shows the fields defined and allows setting them	VC only	Any object	Any object
Settings	Read and modifie runtime VC configuration settings. User interface element – **Administration > vCenter Server Management Server Configuration**	VC only	Any object	Root vCenter Server
System tag	Add or remove system tag.	VC only	Root vCenter Server	Root vCenter Server

Host CIM

Host CIM privileges control the use of CIM for host health monitoring.

Table A-9. Host CIM Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
CIM interaction	Allow a client to obtain a ticket to use for CIM services.	HC and VC	Hosts	Hosts

Host Configuration

Host configuration privileges control the ability to configure hosts.

Table A-10. Host Configuration Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Advanced settings	Set advanced options in host configuration. User interface element – Host **Configuration** tab > **Advanced Settings**, Inventory hierarchy context menu	HC and VC	Hosts	Hosts
Change date and time settings	Sets time and date settings on the host. User interface element – Host **Configuration** tab > **Time Configuration**	HC and VC	Hosts	Hosts

Table A-10. Host Configuration Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Change PciPassthru settings	Change PciPassthru settings for a host. User interface element – Host **Configuration** tab > **Advanced Settings**, Inventory hierarchy context menu	HC and VC	Hosts	Hosts
Change settings	Allows setting of lockdown mode on ESXi hosts only. User interface element – Host **Configuration** tab > **Security Profile > Lockdown Mode > Edit**	HC and VC	Hosts	Hosts (ESXi only)
Change SNMP settings	Configure, restart, and stop SNMP agent. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Hosts	Hosts
Connection	Change the connection status of a host (connected or disconnected). User interface element– Right-click Host	VC only	Hosts	Hosts
Firmware	Update the host firmware on ESXi hosts. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Hosts	Hosts (ESXi only)
Hyperthreading	Enable and disable hyperthreading in a host CPU scheduler. User interface element – Host **Configuration** tab > **Processors**	HC and VC	Hosts	Hosts
Maintenance	Put the host in and out of maintenance mode. Shut down and restart a host. User interface element– Host context menu, **Inventory > Host > Enter Maintenance Mode**	HC and VC	Hosts	Hosts
Memory configuration	Set configured service console memory reservation. This setting is applicable only on ESX hosts. User interface element – Host **Configuration** tab > **Memory**	HC and VC	Hosts	Hosts
Network configuration	Configure network, firewall, and VMotion network. User interface element – Host **Configuration** tab > **Networking**, **Network Adapter**, **DNS and Routing**	HC and VC	Hosts	Hosts
Query Patch	Query for installable patches and install patches on the host.	HC and VC	Hosts	Hosts
Security profile and firewall	Configure internet services, such as SSH, Telnet, SNMP, and host firewall. User interface element– Host **Configuration** tab > **Security Profile**	HC and VC	Hosts	Hosts
Storage partition configuration	Manages VMFS datastore and diagnostic partitions. Scan for new storage devices. Manage iSCSI. User interface element– Host **Configuration** tab > **Storage**, **Storage Adapters**, **Virtual Machine Swapfile Location**Host **Configuration** tab datastore context menu	HC and VC	Hosts	Hosts

Table A-10. Host Configuration Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
System Management	Allows extensions to manipulate the file system on the host. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Hosts	Hosts
System resources	Update the configuration of the system resource hierarchy. User interface element – Host **Configuration** tab > **System Resource Allocation**	HC and VC	Hosts	Hosts
Virtual machine autostart configuration	Change auto-start and auto-stop order of virtual machines on a single host. User interface element– Host **Configuration** tab > **Virtual Machine Startup or Shutdown**	HC and VC	Hosts	Hosts

Host Inventory

Host inventory privileges control adding hosts to the inventory, adding hosts to clusters, and moving hosts in the inventory.

Table A-11. Host Inventory Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Add host to cluster	Add a host to an existing cluster. User interface element – Inventory context menu, **File > New > Add Host**	VC only	Datacenters, Clusters, Host folders	Clusters
Add standalone host	Add a standalone host. User interface element – Toolbar button, Inventory context menu, **Inventory > Datacenter > Add Host**, **File > New > Add Host**, **Hosts** tab context menu	VC only	Datacenters, Host folders	Host folders
Create cluster	Create a new cluster. User interface elements – Toolbar button, inventory context menu, **Inventory > Datacenter > New Cluster**, **File > New > Cluster**	VC only	Datacenters, Host folders	Host folders
Modify cluster	Change the properties of a cluster. User interface element – Inventory context menu, **Inventory > Cluster > Edit Settings**, **Summary** tab	VC only	Datacenters, Host folders, Clusters	Clusters
Move cluster or standalone host	Move a cluster or standalone host between folders. Privilege must be present at both the source and destination. User interface element– Inventory hierarchy	VC only	Datacenters, Host folders, Clusters	Clusters
Move host	Move a set of existing hosts into or out of a cluster. Privilege must be present at both the source and destination. User interface element– Inventory hierarchy drag-and-drop	VC only	Datacenters, Host folders, Clusters	Clusters

Table A-11. Host Inventory Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Remove cluster	Delete a cluster or standalone host. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – Inventory context menu, **Edit > Remove**, **Inventory > Cluster > Remove**	VC only	Datacenters, Host folders, Clusters, Hosts	Clusters, Hosts
Remove host	Remove a host. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – Inventory drag-and-drop out of cluster, context menu, **Inventory > Host > Remove**	VC only	Datacenters, Host folders, Clusters, Hosts	Hosts plus parent object
Rename cluster	Rename a cluster. User interface element– Inventory single click, inventory hierarchy context menu, **Inventory > Cluster > Rename**	VC only	Datacenters, Host folders, Clusters	Clusters

Host Local Operations

Host local operations privileges control actions performed when the vSphere Client is connected directly to a host.

Table A-12. Host Local Operations Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Add host to vCenter	Install and uninstall vCenter agents, such as vpxa and aam, on a host. No user vSphere Client interface elements are associated with this privilege.	HC only	Root host	Root host
Create virtual machine	Create a new virtual machine from scratch on a disk without registering it on the host. No user vSphere Client interface elements are associated with this privilege.	HC only	Root host	Root host
Delete virtual machine	Delete a virtual machine on disk, whether registered or not. No user vSphere Client interface elements are associated with this privilege.	HC only	Root host	Root host
Manage user groups	Manage local accounts on a host. User interface element – **Users & Groups** tab (only present if the vSphere Client logs on to the host directly)	HC only	Root host	Root host
Reconfigure virtual machine	Reconfigure a virtual machine.	HC only	Root host	Root host

Host Profile

Host Profile privileges control operations related to creating and modifying host profiles.

Table A-13. Host Profile Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Clear	Clear profile related information. Apply a profile to a host. User interface element – **Inventory > Host > Host Profile > Apply Profile**	HC and VC	Root vCenter Server	Root vCenter Server
Create	Create a host profile. User interface element – **Create Profile**button on **Profiles** tab	HC and VC	Root vCenter Server	Root vCenter Server
Delete	Delete a host profile. User interface element – **Delete host profile** button when a profile is selected	HC and VC	Root vCenter Server	Root vCenter Server
Edit	Edit a host profile. User interface element – **Edit Profile** button when a profile is selected	HC and VC	Root vCenter Server	Root vCenter Server
View	View a host profile. User interface element – **Host Profiles** button on vSphere Client Home page	HC and VC	Root vCenter Server	Root vCenter Server

Network

Network privileges control tasks related to network management.

Table A-14. Network Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Assign network	Assign a network to a virtual machine.	HC and VC	Networks, Network folders	Networks, Virtual Machines
Configure	Configure a network.	HC and VC	Networks, Network folders	Networks, Virtual Machines

Table A-14. Network Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Move network	Move a network between folders. Privilege must be present at both the source and destination. User interface element – Inventory drag-and-drop	HC and VC	Networks	Networks
Remove	Remove a network. This privilege is deprecated. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element– Inventory network context menu, **Edit > Remove**, **Inventory > Network > Remove**	HC and VC	Networks, Network folders, and Datacenters	Networks

Performance

Performance privileges control modifying performance statistics settings.

Table A-15. Performance Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Modify intervals	Creates, removes, and updates performance data collection intervals. User interface element– **Administration > vCenter Server Management Server Configuration > Statistics**	VC only	Root vCenter Server	Root vCenter Server

Permissions

Permissions privileges control the assigning of roles and permissions.

Table A-16. Permissions Privileges

Privilege Name	Description	Used	Pair with Object	Effective on Object
Modify permission	Define one or more permission rules on an entity, or updates rules if already present for the given user or group on the entity. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – **Permissions** tab context menu, **Inventory > Permissions** menu	HC and VC	All inventory objects	Any object plus parent object
Modify role	Update a role's name and its privileges. User interface element – **Roles** tab context menu, toolbar button, **File** menu	HC and VC	Root vCenter Server	Any object
Reassign role permissions	Reassign all permissions of a role to another role. User interface element – **Delete Role** dialog box, **Reassign affected users** radio button and associated menu	HC and VC	Root vCenter Server	Any object

Resource

Resource privileges control the creation and management of resource pools, as well as the migration of virtual machines.

Table A-17. Resource Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Apply recommendation	Ask the server to go ahead with a suggested VMotion. User interface element – Cluster DRS tab	VC only	Datacenters, Host folders, Clusters	Clusters
Assign vApp to resource pool	Assign a vApp to a resource pool. User interface element – New vApp wizard	HC and VC	Datacenters, Host folders, Clusters, Resource pools, Hosts	Resource pools
Assign virtual machine to resource pool	Assign a virtual machine to a resource pool. User interface element – New Virtual Machine wizard	HC and VC	Datacenters, Host folders, Clusters, Resource pools, Hosts	Resource pools
Create resource pool	Create a new resource pool. User interface element – **File** menu, context menu, **Summary** tab, **Resources** tab	HC and VC	Datacenters, Host folders, Clusters, Resource pools, Hosts	Resource pools, clusters

Table A-17. Resource Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Migrate	Migrate a virtual machine's execution to a specific resource pool or host. User interface element– Inventory context menu, Virtual Machine **Summary** tab, **Inventory > Virtual Machine > Migrate**, drag-and- drop	VC only	Datacenters, Virtual machine folders, Virtual machines	Virtual machines
Modify resource pool	Change the allocations of a resource pool. User interface element – **Inventory > Resource Pool > Remove**, **Resources** tab	HC and VC	Resource pools plus parent object	Resource pools
Move resource pool	Move a resource pool. Privilege must be present at both the source and destination. User interface element – Drag-and-drop	HC and VC	Resource pools, source and destination	Resource pools
Query VMotion	Query the general VMotion compatibility of a virtual machine with a set of hosts. User interface element – Required when displaying the migration wizard for a powered-on VM, to check compatibility	VC only	Root folder	Root folder
Relocate	Cold migrate a virtual machine's execution to a specific resource pool or host. User interface element– Inventory context menu, Virtual Machine **Summary** tab, **Inventory > Virtual Machine > Migrate**, drag-and- drop	VC only	Virtual machines	Virtual machines
Remove resource pool	Delete a resource pool. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – **Edit > Remove**, **Inventory > Resource Pool > Remove**, inventory context menu, **Resources** tab	HC and VC	Resource pools plus parent object	Resource pools
Rename resource pool	Rename a resource pool. User interface element – **Edit > Rename**, **Inventory > Resource Pool > Rename**, context menu	HC and VC	Resource pools	Resource pools

Scheduled Task

Scheduled task privileges control creation, editing, and removal of scheduled tasks.

Table A-18. Scheduled Task Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create tasks	Schedule a task. Required in addition to the privileges to perform the scheduled action at the time of scheduling. User interface element – **Scheduled Tasks** toolbar button and context menu	VC only	Any object	Any object
Modify task	Reconfigure the scheduled task properties. User interface element – **Inventory > Scheduled Tasks > Edit**, **Scheduled Tasks** tab context menu	VC only	Any object	Any object
Remove task	Remove a scheduled task from the queue. User interface element – **Scheduled Tasks** context menu, **Inventory > Scheduled Task > Remove**, **Edit > Remove**	VC only	Any object	Any object
Run task	Run the scheduled task immediately. Creating and running a task also requires permission to perform the associated action. User interface element – **Scheduled Tasks** context menu, **Inventory > Scheduled Task > Run**	VC only	Any object	Any object

Sessions

Sessions privileges control the ability of extensions to open sessions on the vCenter Server.

Table A-19. Session Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Impersonate User	Impersonate another user. This capability is used by extensions.	VC only	Root vCenter Server	Root vCenter Server
Message	Set the global log in message. User interface element – **Sessions** tab, **Administration > Edit Message of the Day**	VC only	Root vCenter Server	Root vCenter Server
Validate session	Verifies session validity.	VC only	Root vCenter Server	Root vCenter Server
View and stop sessions	View sessions. Force log out of one or more logged-on users. User interface element– **Sessions** tab	VC only	Root vCenter Server	Root vCenter Server

Tasks

Tasks privileges control the ability of extensions to create and update tasks on the vCenter Server.

Table A-20. Tasks Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create task	Allows an extension to create a user-defined task.	VC only	Root vCenter Server	Root vCenter Server
Update task	Allows an extension to updates a user-defined task.	VC only	Root vCenter Server	Root vCenter Server

vApp

vApp privileges control operations related to deploying and configuring a vApp.

Table A-21. vApp Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Add virtual machine	Add a virtual machine to a vApp. User interface element – drag-and-drop in the Virtual Machines and Templates or Hosts and Clusters inventory view	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Assign resource pool	Assign a resource pool to a vApp. User interface element – drag-and-drop in the Hosts and Clusters inventory view	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Assign vApp	Assign a vApp to another vApp User interface element – drag-and-drop in the Virtual Machines and Templates or Hosts and Clusters inventory view	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Clone	Clone a vApp. User interface element – **Inventory > vApp > Clone**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Delete	Delete a vApp. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – **Inventory > vApp > Delete from Disk**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Export	Export a vApp from vSphere. User interface element – **File > Export > Export OVF Template**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps

Table A-21. vApp Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Import	Import a vApp into vSphere. User interface element – **File > Deploy OVF Template**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Move	Move a vApp to a new inventory location. User interface element – drag-and-drop in the Virtual Machines and Templates or Hosts and Clusters inventory view	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Power Off	Power off a vApp. User interface element – **Inventory > vApp > Power Off**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Power On	Power on a vApp. User interface element – **Inventory > vApp > Power On**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Rename	Rename a vApp. User interface element – **Inventory > vApp > Rename**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
Unregister	Unregister a vApp. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – **Inventory > vApp > Remove from Inventory**	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
vApp application configuration	Modify a vApp's internal structure, such as product information and properties. User interface element – Edit vApp Settings dialog box, **Options** tab, **Advanced** option	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
vApp instance configuration	Modify a vApp's instance configuration, such as policies. User interface element – Edit vApp Settings dialog box, **Options** tab, **Properties** option and **IP Allocation Policy** option	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps

Table A-21. vApp Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
vApp resource configuration	Modify a vApp's resource configuration. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – Edit vApp Settings dialog box, **Options** tab, **Resources** option	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps
View OVF Environment	View the OVF environment of a powered-on virtual machine within a vApp. User interface element – Virtual Machine Properties dialog box, **Options** tab, **OVF Settings** option, **View** button	HC and VC	Datacenters, clusters, hosts, virtual machine folders, vApps	vApps

Virtual Machine Configuration

Virtual Machine Configuration privileges control the ability to configure virtual machine options and devices.

Table A-22. Virtual Machine Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Add existing disk	Add an existing virtual disk to a virtual machine. User interface element – Virtual Machine Properties dialog box	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Add new disk	Create a new virtual disk to add to a virtual machine. User interface element – Virtual Machine Properties dialog box	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Add or remove device	Add or removes any non-disk device. User interface element – Virtual Machine Properties dialog box	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-22. Virtual Machine Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Advanced	Add or modify advanced parameters in the virtual machine's configuration file. User interface element – Virtual Machine Properties dialog box > **Options** tab > **Advanced** - **General** option > **Configuration Parameters** button	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Change CPU count	Change the number of virtual CPUs. User interface element – Virtual Machine Properties dialog box	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Change resource	Change resource configuration of a set of VM nodes in a given resource pool.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Disk change tracking	Enable or disable change tracking for the virtual machine's disks.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Disk lease	Leases disks for VMware Consolidated Backup. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Extend virtual disk	Expand the size of a virtual disk.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-22. Virtual Machine Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Host USB device	Attach a host-based USB device to a virtual machine. Adding USB devices to virtual machines on ESX/ESXi hosts is not supported.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Memory	Change the amount of memory allocated to the virtual machine. User interface element – Virtual Machine Properties dialog box > **Memory**	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Modify device settings	Change the properties of an existing device. User interface element – Virtual Machine Properties dialog box > SCSI/IDE node selection	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Query unowned files	Query unowned files.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Raw device	Add or removes a raw disk mapping or SCSI pass through device. Setting this parameter overrides any other privilege for modifying raw devices, including connection states. User interface element – Virtual Machine Properties > Add/Remove raw disk mapping	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Remove disk	Remove a virtual disk device. User interface element – Virtual Machine Properties dialog box > Hard Disk (but not a raw disk mapping)	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-22. Virtual Machine Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Rename	Rename a virtual machine or modifies the associated notes of a virtual machine. User interface element– Virtual Machine Properties dialog box, inventory, inventory context menu, **File** menu, **Inventory** menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Reset guest information	Edit the guest operating system information for a virtual machine User interface element – Virtual Machine Properties dialog box **Options** tab,	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Settings	Change general VM settings. User interface element – Virtual Machine Properties dialog box **Options** tab, **General Options** option	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Swapfile placement	Change the swapfile placement policy for a virtual machine. User interface element – Virtual Machine Properties dialog box **Options** tab, **Swapfile Location** option	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Upgrade virtual hardware	Upgrade the virtual machine's virtual hardware version from a previous version of VMware. User interface element – context menu, **File** menu (appears only if vmx file shows a lower configuration number)	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Virtual Machine Interaction

Virtual Machine Interaction privileges control the ability to interact with a virtual machine console, configure media, perform power operations, and install VMware Tools.

Table A-23. Virtual Machine Interaction

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Answer question	Resolve issues with VM state transitions or runtime errors. User interface element – **Summary** tab, Inventory menu, context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Backup operation on virtual machine	Perform backup operations on virtual machines.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Configure CD media	Configure a virtual DVD or CD-ROM device. User interface element – Virtual Machine Properties dialog box > DVD/CD-ROM	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Configure floppy media	Configure a virtual floppy device. User interface element – Virtual Machine Properties dialog box, **Summary** tab **Edit Settings**	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Console interaction	Interact with the virtual machine's virtual mouse, keyboard, and screen. User interface element– **Console** tab, toolbar button, **Inventory > Virtual Machine > Open Console**, inventory context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-23. Virtual Machine Interaction (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create screenshot	Create a virtual machinescreen shot.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Defragment all disks	Defragment all disks on the virtual machine.	HC and VC.	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Device connection	Change the connected state of a virtual machine's disconnectable virtual devices. User interface element– Virtual Machine Properties dialog box, **Summary** tab **Edit Settings**	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Disable Fault Tolerance	Disable the Secondary virtual machine for a virtual machine using Fault Tolerance. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Disable Fault Tolerance**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Enable Fault Tolerance	Enable the Seocondary virtual machine for a virtual machine using Fault Tolerance. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Enable Fault Tolerance**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Power Off	Power off a powered-on virtual machine, shuts down guest. User interface element – **Inventory > Virtual Machine > Power > Power Off**, **Summary** tab, toolbar button, virtual machine context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-23. Virtual Machine Interaction (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Power On	Power on a powered-off virtual machine, resumes a suspended virtual machine. User interface element– **Inventory > Virtual Machine > Power > Power On**, **Summary** tab, toolbar button, virtual machine context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Record session on Virtual Machine	Record a session on a virtual machine. No vSphere Client user interface elements are associated with this privilege.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Replay session on Virtual Machine	Replay a recorded session on a virtual machine. No vSphere Client user interface elements are associated with this privilege.	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Reset	Resets virtual machine and reboots the guest operating system. User interface element – **Inventory > Virtual Machine > Power > Reset**, **Summary** tab, toolbar button, virtual machine context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Suspend	Suspends a powered-on virtual machine, puts guest in standby mode. User interface element – **Inventory > Virtual Machine > Power > Suspend**, **Summary** tab, toolbar button, virtual machine context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Test failover	Test Fault Tolerance failover by making the Secondary virtual machine the Primary virtual machine. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Test Failover**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Table A-23. Virtual Machine Interaction (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Test restart Secondary VM	Terminate a Secondary virtual machine for a virtual machine using Fault Tolerance. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Test Restart Secondary**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Turn Off Fault Tolerance	Turn off Fault Tolerance for a virtual machine. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Turn Off Fault Tolerance**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
Turn On Fault Tolerance	Turn on Fault Tolerance for a virtual machine. User interface element – **Inventory > Virtual Machine > Fault Tolerance > Turn On Fault Tolerance**	VC only	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines
VMware Tools install	Mounts and unmounts the VMware Tools CD installer as a CD-ROM for the guest operating system. User interface element– **Inventory > Virtual Machine > Guest > Install/Upgrade VMware Tools**,virtual machine context menu	HC and VC	Datacenters, Hosts, Clusters, Virtual machine folders, Resource pools, Virtual machines	Virtual machines

Virtual Machine Inventory

Virtual Machine Inventory privileges control adding, moving, and removing virtual machines.

Table A-24. Virtual Machine Inventory Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create from existing	Create a virtual machine based on an existing virtual machine or template, by cloning or deploying from a template.	HC and VC	Datacenters, Clusters, Hosts, Virtual machine folders	Clusters, Hosts, Virtual machine folders
Create new	Create a new virtual machine and allocates resources for its execution. User interface element– **File** menu, context menu, **Summary** tab - **New Virtual Machine** links	HC and VC	Datacenters, Clusters, Hosts, Virtual machine folders	Clusters, Hosts, Virtual machine folders

Table A-24. Virtual Machine Inventory Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Move	Relocate a virtual machine in the hierarchy. Privilege must be present at both the source and destination. User interface element – Inventory hierarchy drag-and-drop in Virtual Machines & Templates view	VC only	Datacenters, Clusters, Hosts, Virtual machine folders, Virtual machines	Virtual machines
Register	Add an existing virtual machine to a vCenter Server or host inventory.	HC and VC	Datacenters, Clusters, Hosts, Virtual machine folders	Clusters, Hosts, Virtual machine folders
Remove	Delete a virtual machine, removing its underlying files from disk. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object. User interface element – **File** menu, context menu, **Summary** tab	HC and VC	Datacenters, Clusters, Hosts, Virtual machine folders, Virtual machines	Virtual machines
Unregister	Unregister a virtual machine from a vCenter Server or host inventory. In order to have permission to perform this operation, you must have this privilege assigned to both the object and its parent object.	HC and VC	Datacenters, Clusters, Hosts, Virtual machines, virtual machine folders	Virtual machines

Virtual Machine Provisioning

Virtual Machine Provisioning privileges control activities related to deploying and customizing virtual machines.

Table A-25. Virtual Machine Provisioning Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Allow disk access	Open a disk on a virtual machine for random read and write access. Used mostly for remote disk mounting. No user vSphere Client interface elements are associated with this privilege.	n/a	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Allow read-only disk access	Open a disk on a virtual machine for random read access. Used mostly for remote disk mounting. No user vSphere Client interface elements are associated with this privilege.	n/a	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines

Table A-25. Virtual Machine Provisioning Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Allow virtual machine download	Read files associated with a virtual machine, including vmx, disks, logs, and nvram. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Root folders
Allow virtual machine files upload	Write files associated with a virtual machine, including vmx, disks, logs, and nvram. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Root folders
Clone template	Clone a template. User interface element– **Inventory > Virtual Machine > Template > Clone**, context menu, **Virtual Machines** tab	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Templates	Templates
Clone virtual machine	Clone an existing virtual machine and allocates resources. User interface element – **Inventory > Virtual Machine > Clone**, context menu, **Summary** tab	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Create template from virtual machine	Create a new template from a virtual machine. User interface element – **Inventory > Virtual Machine > Template > Clone to Template**, context menu, **Summary** tab items	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Customize	Customize a virtual machine's guest operating system without moving the virtual machine. User interface element– Clone Virtual Machine wizard: Guest Customization	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Deploy template	Deploy a virtual machine from a template. User interface element – "Deploy to template" **File** menu, context menu items, **Virtual Machines** tab	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Templates	Templates

Table A-25. Virtual Machine Provisioning Privileges (Continued)

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Mark as template	Mark an existing, powered off virtual machine as a template. User interface element – **Inventory > Virtual Machine > Template > Convert to Template**, context menu items, **Virtual Machines** tab, **Summary** tab	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Mark as virtual machine	Mark an existing template as a VM. User interface element – "Convert to Virtual Machine..." context menu items, **Virtual Machines** tab	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Templates	Templates
Modify customization specification	Create, modify, or delete customization specifications. User interface element – Customization Specifications Manager	VC only	Root vCenter Server	Root vCenter Server
Promote disks	Promote a virtual machine's disks.	VC only	Datacenters, Hosts, Clusters, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Read customization specification	View the customization specifications defined on the system. User interface element – **Edit > Customization Specifications**	VC only	Root vCenter Server	Root vCenter Server

Virtual Machine State

Virtual machine state privileges control the ability to take, delete, rename, and restore snapshots.

Table A-26. Virtual Machine State Privileges

Privilege Name	Description	Affects	Pair with Object	Effective on Object
Create snapshot	Create a new snapshot from the virtual machine's current state. User interface element – virtual machine context menu, toolbar button, **Inventory > Virtual Machine > Snapshot > Take Snapshot**	HC and VC	Datacenters, Clusters, Hosts, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Remove Snapshot	Remove a snapshot from the snapshot history. User interface element – virtual machine context menu, toolbar button, **Inventory** menu	HC and VC	Datacenters, Clusters, Hosts, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Rename Snapshot	Rename this snapshot with either a new name or a new description or both. No user vSphere Client interface elements are associated with this privilege.	HC and VC	Datacenters, Clusters, Hosts, Resource pools, Virtual machine folders, Virtual machines	Virtual machines
Revert to snapshot	Set the VM to the state it was in at a given snapshot. User interface element – virtual machine context menu, toolbar button, **Inventory > Virtual Machine > Snapshot > Revert to Snapshot**, **Virtual Machines** tab	HC and VC	Datacenters, Clusters, Hosts, Resource pools, Virtual machine folders, Virtual machines	Virtual machines

Installing the Microsoft Sysprep Tools

B

The Microsoft System Preparation tools enable you to customize guest Windows operating systems.

Using System Preparation tools is especially useful when you clone virtual machines. The guest operating system customization feature in vCenter Server leverages the functionality of the System Preparation tools. Ensure that your vCenter Server system meets the following requirements before you customize your virtual machine's Windows guest operating systems:

- Install Microsoft System Preparation tools. Microsoft includes the system tool set on the installation CD-ROM discs for Windows 2000, Windows XP, and Windows 2003. System Preparation tools are built into the Windows Vista operating system.
- Ensure that the correct versions of the System Preparation tools are installed for each guest operating system you want to customize.
- Ensure that the password for the local administrator account on the virtual machines is set to blank ("").

NOTE Customization operations will fail if the correct version of sysprep tools is not found.

This appendix includes the following topics:

- "Install the Microsoft System Preparation Tools from a Microsoft Web Site Download," on page 327
- "Install the Microsoft Sysprep Tools from the Windows Operating System CD," on page 328

Install the Microsoft System Preparation Tools from a Microsoft Web Site Download

You can download and install Microsoft System Preparation tools from the Microsoft Web site.

Ensure you download the correct version for the guest operating system that you want to customize.

Procedure

1 Open a browser window and navigate to the Microsoft Download Center.

2 Navigate to the page that contains the download link to the version of the tools you want.

3 Click **Download** and save the file to your local disk.

4 Open and expand the `.cab` file, using a tool such as Winzip.exe or another tool capable of reading Microsoft CAB files.

5 Extract the files to the provided directory.

The following System Preparation tools support directories were created during vCenter Server installation:

```
C:\<ALLUSERSPROFILE>\Application Data\Vmware\VMware VirtualCenter\sysprep
...\1.1\
...\2k\
...\xp\
...\svr2003\
...\xp-64\
...\svr2003-64\
```

where <*ALLUSERSPROFILE*> is usually `\Documents And Settings\All Users\`. This is where `vpxd.cfg` is also located.

Select the subdirectory that corresponds to your operating system.

6 Click **OK** to expand the files.

After you have extracted the files from the `.cab` file, you should see:

```
...\<guest>\deptool.chm
...\<guest>\readme.txt
...\<guest>\setupcl.exe
...\<guest>\setupmgr.exe
...\<guest>\setupmgx.dll
...\<guest>\sysprep.exe
...\<guest>\unattend.doc
```

where <*guest*> is 2k, xp, svr2003, xp-64, or svr2003-64.

What to do next

You are now ready to customize a new virtual machine with a supported Windows guest operating system when you clone an existing virtual machine.

Install the Microsoft Sysprep Tools from the Windows Operating System CD

You can install the Microsoft Sysprep tools from a CD.

Procedure

1 Insert the Windows operating system CD into the CD-ROM drive (often the D: drive).

2 Locate the `DEPLOY.CAB` file in the CD directory, `\Support\Tools`.

3 Open and expand the `DEPLOY.CAB` file, using a tool such as Winzip.exe or another tool capable of reading Microsoft CAB files.

4 Extract the files to the directory appropriate to your Sysprep guest operating system.

The following Sysprep support directories were created during vCenter Server installation:

```
C:\<ALLUSERSPROFILE>\Application Data\Vmware\VMware VirtualCenter\sysprep
...\1.1\
...\2k\
...\xp\
...\svr2003\
...\xp-64\
...\svr2003-64\
```

where <*ALLUSERSPROFILE*> is usually `\Documents And Settings\All Users\`. This is where `vpxd.cfg` is also located.

Select the subdirectory that corresponds to your operating system.

5 Click **OK** to expand the files.

After you have extracted the files from the `.cab` file, you should see:

```
...\<guest>\deptool.chm
...\<guest>\readme.txt
...\<guest>\setupcl.exe
...\<guest>\setupmgr.exe
...\<guest>\setupmgx.dll
...\<guest>\sysprep.exe
...\<guest>\unattend.doc
```

where <*guest*> is 2k, xp, svr2003, xp-64, or svr2003-64.

6 Repeat this procedure to extract Sysprep files for each of the Windows guest operating systems (Windows 2000, Windows XP, or Windows 2003) you plan to customize using vCenter Server.

What to do next

You are now ready to customize a new virtual machine with a supported Windows guest operating system when you clone an existing virtual machine.

Performance Metrics

C

Performance metrics are collected on ESX/ESXi servers and vCenter Servers for managed objects and the physical and virtual devices associated with these objects. Each object and device has its own set of data counters that provide the metadata for the metrics.

The performance metrics for VMware vSphere are organized into tables for each metric group: cluster services, CPU, disk, management agent, memory, network, system, and virtual machine operations. Each table contains the following information:

Counter Lists the display name of each data counter.

Label Indicates the name of the data counter as displayed in the APIs and advanced performance charts. In some cases the labels are different in the overview performance charts.

Description Provides a brief description of the metric.

Stats Type Measurement used during the statistics interval. The Stats Type is related to the unit of measurement and can be one of the following:

- Rate - Value over the current statistics interval.
- Delta - Change from previous statistics interval.
- Absolute - Absolute value, independent of the statistics interval .

Unit How the statistic quantity is measured across the collection interval, for example, kiloBytes (KB) and kiloBytesPerSecond (KBps).

NOTE For some statistics, the value is converted before it is displayed in the overview performance charts. For example, memory usage is displayed in KiloBytes by the APIs and the advanced performance charts, but it is displayed in MegaBytes in the overview performance charts.

Rollup Type Indicates the calculation method used during the statistics interval to roll up data. Determines the type of statistical values that are returned for the counter. For real-time data, the value shown is the current value. One of:

- Average - Data collected is averaged.
- Minimum - The minimum value collected is rolled up.
- Maximum - The maximum value collected is rolled up.
- Summation - Data collected is summed.
- Latest - Data collected is the most recent value.

Collection Level Indicates the minimum value to which the statistics collection level must be set for the metric to be gathered during each collection interval. You can assign a collection level of 1 to 4 to each collection interval enabled on your vCenter Server, with 4 containing the most data counters.

V H R C D Indicates the entity for which the counter applies. One of:

- V – virtual machines
- H – hosts
- R – resource pools
- C – compute resources
- D – datastores

Calculations for all metrics listed in the data counter tables are for the duration of the data collection cycle. Collection cycle durations are specified with the Statistics Collection Interval setting.

NOTE The availability of some data counters in the vSphere Client depends on the statistics Collection Level set for the vCenter Server. The entire set of data counters are collected and available in vCenter Server. You can use the vShpere Web Services SDK to query vCenter Server and get statistics for all counters. For more information, see the *VMware vSphere API Reference*.

This appendix includes the following topics:

- "Cluster Services Metrics," on page 332
- "CPU Metrics," on page 333
- "Disk Metrics," on page 337
- "Management Agent Metrics," on page 341
- "Memory Metrics," on page 342
- "Network Metrics," on page 350
- "Storage Utilization Metrics," on page 352
- "System Metrics," on page 353
- "Virtual Machine Operations Metrics," on page 354

Cluster Services Metrics

The cluster-services metric group (clusterServices) tracks performance statistics for clusters configured by using VMware DRS (distributed resource scheduler), VMware HA (high availability), or both.

Table C-1 lists the cluster services data counters.

NOTE The cluster services metrics appear only in the advanced performance charts.

Table C-1. Cluster Services Data Counters

Counter	Label	Description	Entity V	H	R	C
cpufairness	CPU Fairness	Fairness of distributed CPU resource allocation. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Collection Level: 1 ■ VC/ESX: Yes/No	o	•	o	o
effectivecpu	Effective CPU Resources	Total available CPU resources of all hosts within a cluster. Effective CPU = Aggregate host CPU capacity – VMkernel CPU + Service Console CPU + other service CPU) ■ Stats Type: rate ■ Unit: megaHertz ■ Rollup Type: average ■ Collection Level: 1 ■ VC/ESX: Yes/No	o	o	o	•
effectivemem	Effective Memory Resources	Total amount of machine memory of all hosts in the cluster that is available for virtual machine memory (physical memory for use by the Guest OS) and virtual machine overhead memory. Effective Memory = Aggregate host machine memory – (VMkernel memory + Service Console memory + other service memory) ■ Stats Type: absolute ■ Unit: megaBytes ■ Rollup Type: average ■ Collection Level: 1 ■ VC/ESX: Yes/No	o	o	o	•
failover	Current Failover Level	Number of VMware HA failures that can be tolerated. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1 ■ VC/ESX: Yes/No	o	o	o	•
memfairness	Memory Fairness	Aggregate available memory resources of all hosts within a cluster. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1 ■ VC/ESX: Yes/No	o	•	o	o

CPU Metrics

The cpu metric group tracks CPU utilization for hosts, virtual machines, resource pools, and compute resources.

Table C-2 lists the CPU data counters.

NOTE The performance charts display a subset of the CPU data counters. The entire set is collected and available in vCenter Server. You can use the vSphere Web Services SDK to query vCenter Server and get statistics for those counters. For more information, see the *VMware vSphere API Reference*.

Table C-2. CPU Data Counters

Counter	Label	Description	V	H	R	C
cpuentitlement	Worst Case Allocation (virtual machine **Resource Allocation** tab)	Amount of CPU resources allocated to the virtual machine or resource pool based on the total cluster capacity and the resource configuration (reservations, shares, and limits) on the resource hierarchy. cpuentitlement is computed based on an ideal scenario in which all virtual machines are completely busy and the load is perfectly balanced across all hosts. This counter is for internal use only and is not useful for performance monitoring. ■ Stats Type: absolute ■ Unit: megaHertz ■ Rollup Type: latest ■ Collection Level: 1 ■ VC/ESX: No/Yes	•	o	•	o
guaranteed	CPU Guaranteed	Not supported for ESX 4.x systems, except through vCenter Server. CPU time that is reserved for the entity. For virtual machines, this measures CPU time that is reserved, per virtual CPU (vCPU). This counter has been deprecated and should not be used to monitor performance. ■ Stats Type: delta ■ Unit: millisecond ■ Rollup Type: latest ■ Collection Level: 3 ■ VC/ESX: Yes/No	•	o	o	o
idle	CPU Idle	Total time that the CPU spent in an idle state (meaning that a virtual machine is not runnable). This counter represents the variance, in milliseconds, during the interval. ■ Stats Type: delta ■ Unit: millisecond ■ Rollup Type: summation ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	•	o	o	o
ready	CPU Ready	Percentage of time that the virtual machine was ready, but could not get scheduled to run on the physical CPU. CPU ready time is dependent on the number of virtual machines on the host and their CPU loads. ■ Stats Type: rate ■ Unit: percentage ■ Rollup Type: summation ■ Collection Level: 1 ■ VC/ESX: Yes/Yes	•	o	o	o
reservedCapacity	CPU Reserved Capacity	Total CPU capacity reserved by the virtual machines. ■ Stats Type: absolute ■ Unit: megaHertz ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	•

Table C-2. CPU Data Counters (Continued)

Counter	Label	Description	V	H	R	C
system	CPU System	Amount of time spent on system processes on each virtual CPU in the virtual machine. This is the host view of the CPU usage, not the guest operating system view. ■ Stats Type: delta ■ Unit: millisecond ■ Rollup Type: summation ■ Collection Level: 3 ■ VC/ESX: Yes/Yes	•	o	o	o

totalmhz	CPU Total	Total amount of CPU resources of all hosts in the cluster. The maximum value is equal to the frequency of the processors multiplied by the number of cores.
		`totalmhz = CPU frequency × number of cores`
		For example, a cluster has two hosts, each of which has four CPUs that are 3GHz each, and one virtual machine that has two virtual CPUs.
		`VM totalmhz = 2 vCPUs × 3000MHz = 6000MHz`
		`Host totalmhz = 4 CPUs × 3000MHz = 12000MHz`
		`Cluster totalmhz = 2 x 4 × 3000MHz = 24000MHz`
		■ Stats Type: rate
		■ Unit: megaHertz
		■ Rollup Type: average
		■ Collection Level: 1
		■ VC/ESX: Yes/Yes
			o	o	o	•

Table C-2. CPU Data Counters (Continued)

Counter	Label	Description	V	H	R	C

usage	CPU Usage	CPU usage as a percentage during the interval.
		VM Amount of actively used virtual CPU, as a percentage of total available CPU. This is the host's view of the CPU usage, not the guest operating system view. It is the average CPU utilization over all available virtual CPUs in the virtual machine. For example, if a virtual machine with one virtual CPU is running on a host that has four physical CPUs and the CPU usage is 100%, the virtual machine is using one physical CPU completely.
		`virtual CPU usage = usagemhz ÷ (# of virtual CPUs × core frequency)`
		Host Actively used CPU of the host, as a percentage of the total available CPU. Active CPU is approximately equal to the ratio of the used CPU to the available CPU.
		`available CPU = # of physical CPUs × clock rate`
		100% represents all CPUs on the host. For example, if a four-CPU host is running a virtual machine with two CPUs, and the usage is 50%, the host is using two CPUs completely.
		Cluster Sum of actively used CPU of all virtual machines in the cluster, as a percentage of the total available CPU.
		`CPU Usage = CPU usagemhz ÷ effectivecpu`
		■ Stats Type: rate
		■ Unit: percent
		■ Rollup Type: average (min/max)
		■ Collection Level: 1(4)
		■ VC/ESX: Yes/Yes
			•	•	•	•

Table C-2. CPU Data Counters (Continued)

Counter	Label	Description	V	H	R	C
usagemhz	CPU Usage in MHz	The amount of CPU used, in megahertz, during the interval. **VM** Amount of actively used virtual CPU. This is the host's view of the CPU usage, not the guest operating system view. **Host** Sum of the actively used CPU of all powered on virtual machines on a host. The maximum possible value is the frequency of the processors multiplied by the number of processors. For example, if you have a host with four 2GHz CPUs running a virtual machine that is using 4000MHz, the host is using two CPUs completely. `4000 ÷ (4 × 2000) = 0.50` ■ Stats Type: rate ■ Unit: megaHertz ■ Rollup Type: average(min/max) ■ Collection Level: 1(4) ■ VC/ESX: Yes/Yes	•	•	•	•
used	CPU Used	Amount of used CPU time. ■ Stats Type: delta ■ Unit: millisecond ■ Rollup Type: summation ■ Collection Level: 3 ■ VC/ESX: Yes/Yes	•	o	o	o
wait	CPU Wait	Amount of CPU time spent in wait state. ■ Stats Type: delta ■ Unit: millisecond ■ Rollup Type: summation ■ Collection Level: 3 ■ VC/ESX: Yes/Yes	•	o	o	o

Disk Metrics

The disk metric group tracks statistics for disk input/output (I/O) performance.

Disk I/O counters support metrics for both physical devices and virtual devices. A host reads data from a LUN (logical unit number) associated with the physical storage media. A virtual machine reads data from a virtual disk, which is the virtual hardware presented to the Guest OS running on the virtual machine. The virtual disk is a file in VMDK format.

Table C-3 lists the disk data counters.

NOTE Some counters listed in Table C-3 subsume other counters. For example, kernelLatency includes both queueReadLatency and queueWriteLatency and the disk usage statistic include both read and write statistics. In addition, only a subset of the disk counters appear in the overview performance charts. To view all disk data counters, use the advanced performance charts.

Table C-3. Disk Data Counters

Counter	Label	Description	Entity V	H	R	C
commands	Disk Commands Issued	Number of SCSI commands issued during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	•	•	o	o
commandsAborted	Disk Command Aborts	Number of SCSI commands aborted during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	•	•	o	o
deviceLatency	Physical Device Command Latency	Average amount of time, in milliseconds, to complete a SCSI command from the physical device. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
deviceReadLatency	Physical Device Read Latency	Average amount of time, in milliseconds, to complete read from the physical device. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
deviceWriteLatency	Physical Device Write Latency	Average amount of time, in milliseconds, to write to the physical device (LUN). ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
kernelLatency	Kernel Disk Command Latency	Average amount of time, in milliseconds, spent by VMkernel processing each SCSI command. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
kernelReadLatency	Kernel Disk Read Latency	Average amount of time, in milliseconds, spent by VMKernel processing each SCSI read command. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o

Table C-3. Disk Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
kernelWriteLatency	Kernel Disk Write Latency	Average amount of time, in milliseconds, spent by VMKernel processing each SCSI write command. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
maxTotalLatency	Highest Disk Latency	Highest latency value across all disks used by the host. Latency measures the time taken to process a SCSI command issued by the guest OS to the virtual machine. The kernel latency is the time VMkernel takes to process an IO request. The device latency is the time it takes the hardware to handle the request. `Total latency = kernelLatency + deviceLatency` ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 1 ■ VC/ESX: Yes/Yes	o	•	o	o
numberRead	Disk Read Requests	**VM** Number of times data was read from each virtual disk on the virtual machine. **Host** Number of times data was read from each LUN on the host during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 3 ■ VC/ESX: Yes/Yes	•	•	o	o
numberWrite	Disk Write Requests	**VM** Number of times data was written to each virtual disk on the virtual machine. **Host** Number of times data was written to each LUN on the host during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 3 ■ VC/ESX: Yes/Yes	•	•	o	o
queueLatency	Queue Command Latency	Average amount of time spent in the VMkernel queue, per SCSI command, during the collection interval. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o

Table C-3. Disk Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
queueReadLatency	Queue Read Latency	Average amount of time taken during the collection interval per SCSI read command in the VMKernel queue. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
queueWriteLatency	Queue Write Latency	Average amount time taken during the collection interval per SCSI write command in the VMKernel queue. ■ Stats Type: absolute ■ Unit: millisecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	o	•	o	o
read	Disk Read Rate	**VM** Rate at which data is read from each virtual disk on the virtual machine. **Host** Rate at which data is read from each LUN on the host. `read rate = # blocksRead per second × blockSize` ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Rollup Type: average ■ Collection Level: 2 ■ VC/ESX: Yes/Yes	•	•	o	o
totalLatency	Disk Command Latency	Average amount of time taken during the collection interval to process a SCSI command issued by the Guest OS to the virtual machine. The sum of kernelLatency and deviceLatency. ■ Stats Type: absolute ■ Unit: millisecond ■ Collection Level: 2 ■ Rollup Type: average ■ VC/ESX: Yes/Yes	o	•	o	o
totalReadLatency	Disk Read Latency	Average amount of time taken during the collection interval to process a SCSI read command issued from the Guest OS to the virtual machine. The sum of kernelReadLatency and deviceReadLatency. ■ Stats Type: absolute ■ Unit: millisecond ■ Collection Level: 2 ■ Rollup Type: average ■ VC/ESX: Yes/Yes	o	•	o	o

Table C-3. Disk Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
totalWriteLatency	Disk Write Latency	Average amount of time taken during the collection interval to process a SCSI write command issued by the Guest OS to the virtual machine. The sum of kernelWriteLatency and deviceWriteLatency. ■ Stats Type: absolute ■ Unit: millisecond ■ Collection Level: 2 ■ Rollup Type: average ■ VC/ESX: Yes/Yes	o	•	o	o
usage	Disk Usage	Aggregated disk I/O rate. For hosts, this metric includes the rates for all virtual machines running on the host during the collection interval. ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Collection Level: 1(4) ■ Rollup Type: average (min/max) ■ VC/ESX: Yes/Yes	•	•	o	o
write	Disk Write Rate	**VM** Rate at which data is written to each virtual disk on the virtual machine. **Host** Rate at which data is written to each LUN on the host. `Write rate = blocksWritten/second * blockSize` ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Collection Level: 2 ■ Rollup Type: average ■ VC/ESX: Yes/Yes	•	•	o	o

Management Agent Metrics

The management agent metric group tracks consumption of resources by the various management agents (hostd, vpxd, and so on) running on the ESX/ESXi host.

Table C-4 lists the management agent data counters.

NOTE The management agent metrics appear only in the advanced performance charts.

Table C-4. Management Agent Metrics

Counter	Label	Description	Entity V	H	R	C
memUsed	Memory Used	Amount of total configured memory available for use. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average ■ Collection Level: 3	o	•	o	o
swapUsed	Memory Swap Used	Sum of the memory swapped by all powered-on virtual machines on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average ■ Collection Level: 3	o	•	o	o
swapIn	Memory Swap In	Amount of memory swapped in for the Service Console. Use this counter to determine whether to increase the amount of memory dedicated to the service console. ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Rollup Type: average ■ Collection Level: 3	o	•	o	o
swapOut	Memory Swap Out	Amount of memory swapped out for the Service Console. Use this counter to determine whether to decrease the amount of memory dedicated to the service console. ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Rollup Type: average ■ Collection Level: 3	o	•	o	o

Memory Metrics

The memory metric group tracks memory statistics for virtual machines, hosts, resource pools, and compute resources.

Interpret the data counter definitions in the context of the entity to which it applies, as follows:

- For virtual machines, memory refers to guest physical memory. Guest physical memory is the amount of physical memory presented as a virtual-hardware component to the virtual machine, at creation time, and made available when the virtual machine is running.
- For hosts, memory refers to machine memory. Machine memory is the random-access memory (RAM) that is actually installed in the hardware that comprises the ESX/ESXi host.

Table C-5 lists the memory data counters.

NOTE Only a subset of memory counters appear in the overview charts. To view all memory data counters, use the advanced performance charts.

Table C-5. Memory Data Counters

Counter	Label	Description		Entity V	H	R	C
active	Memory Active	Amount of memory actively used, as estimated by VMkernel. Active memory is based on the current workload of the virtual machine or host.		•	•	•	•
		VM	Amount of guest physical memory in use by the virtual machine. Active memory is estimated by VMkernel statistical sampling and represents the actual amount of memory the virtual machine needs.				
		Host	Sum of the active guest physical memory of all powered on virtual machines on the host, plus memory used by basic VMKernel applications on the host.				
		■ Stats Type: absolute ■ Unit: KiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)					
consumed	Memory Consumed	**VM**	Amount of guest physical memory consumed by the virtual machine for guest memory. Consumed memory does not include overhead memory. It includes shared memory and memory that might be reserved, but not actually used. It does not include overhead memory. vm consumed memory = memory granted - memory saved due to memory sharing	•	•	•	•
		Host	Amount of machine memory used on the host. Consumed memory includes memory used by virtual machines, the service console, VMkernel, and vSphere services, plus the total consumed memory for all running virtual machines. host consumed memory = total host memory - free host memory				
		Cluster	Amount of host machine memory used by all powered on virtual machines in the cluster. A cluster's consumed memory consists of virtual machine consumed memory and overhead memory. It does not include host-specific overhead memory, such as memory used by the service console or VMkernel.				
		■ Stats Type: absolute ■ Unit: KiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)					

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description		Entity V	H	R	C
granted	Memory Granted	**VM**	The amount of guest physical memory that is mapped to machine memory. Includes shared memory amount. The amount of guest physical memory currently mapped to machine memory, including shared memory, but excluding overhead.	•	•	•	•
		Host	The total of all granted metrics for all powered-on virtual machines, plus memory for vSphere services on the host.				
		■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)					
heap	Memory Heap	Amount of VMkernel virtual address space dedicated to VMkernel main heap and related data. This counter is for internal use only and is not useful for performance monitoring. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)		o	•	o	o
heapfree	Memory Heap Free	Amount of free address space in the VMkernel's main heap. Heap Free varies, depending on the number of physical devices and various configuration options. There is no direct way for the user to increase or decrease this statistic. This counter is for internal use only and is not useful for performance monitoring. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)		•	o	o	o
mementitlement	Worst Case Allocation (virtual machine **Resource Allocation** tab)	Memory allocation as calculated by the VMkernel scheduler based on current estimated demand, and the reservation, limit, and shares policies set for all virtual machines and resource pools in the host or cluster. This counter is for internal use only and is not useful for performance monitoring. ■ Stats Type: absolute ■ Unit: megaBytes ■ Rollup Type: latest ■ Collection Level: 1		o	•	o	o
memUsed	Memory Used	Amount of used memory. Sum of the memory used by all powered on virtual machines and vSphere services on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 3		o	•	o	o

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
overhead	Memory Overhead	Amount of additional machine memory allocated to a virtual machine for overhead. The overhead amount is beyond the reserved amount. **VM** — Amount of machine memory used by the VMkernel to run the virtual machine. **Host** — Total of all overhead metrics for powered-on virtual machines, plus the overhead of running vSphere services on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	o	o	o
reservedCapacity	Memory Reserved Capacity	Total amount of memory reservation used by powered on VMs and vSphere services on the host. Includes overhead amount. ■ Stats Type: absolute ■ Unit: megaBytes ■ Rollup Type: average ■ Collection Level: 2	o	•	o	•
shared	Memory Shared	**VM** — Amount of guest physical memory that is shared with other virtual machines (through the VMkernel's transparent page-sharing mechanism, a RAM de-duplication technique). The value of shared includes the size of the zero memory area. **Host** — Sum of the shared memory values of all powered-on virtual machines, plus the amount for the vSphere services on the host. The host's Memory Shared may be larger than the amount of machine memory if memory is overcommitted (the aggregate virtual machine configured memory is much greater than machine memory). The value of this statistic reflects how effective transparent page sharing and memory overcommitment are for saving machine memory. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	•	o	o
sharedcommon	Memory Shared Common	Amount of machine memory that is shared by all powered-on virtual machines and vSphere services on the host. `Memory Shared – Memory Shared Common = Host memory saved by sharing` ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	o	•	o	o

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
state	Memory State	Amount of free machine memory on the host. VMkernel has four free-memory thresholds that affect the mechanisms used for memory reclamation. **0 (High)** `Free memory >= 6% of machine memory – service console memory` **1 (Soft)** `Free memory >= 4% of machine memory – service console memory` **2 (Hard)** `Free memory >= 2% of machine memory – service console memory` **3 (Low)** `Free memory >= 1% of machine memory – service console memory` For `0` and `1`, swapping is favored over ballooning. For `2` and `3`, ballooning is favored over swapping. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 2	•	•	o	o
swapin	Memory Swap In	Amount of memory that has been swapped in to memory from disk. **VM** Total amount of memory data that has been read in from the virtual machine's swap file to machine memory by the VMkernel. This statistic refers to VMkernel swapping and not to guest OS swapping. **Host** Sum of memory swapin of all powered on VMs on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	•	o	o
swapinRate	Memory Swap In Rate	Rate at which memory is swapped from disk into active memory during the current interval. This counter applies to virtual machines and is generally more useful than the swapin counter to determine if the virtual machine is running slow due to swapping, especially when looking at real-time statistics. ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	•	o	o

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
swapout	Memory Swap Out	Amount of memory that has been swapped out to disk. **VM** Total amount of memory data that has been written out to the virtual machine's swap file from machine memory by the VMkernel. This statistic refers to VMkernel swapping and not to guest OS swapping. **Host** Sum of Memory Swap Out of all powered on VMs on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	•	o	o
swapoutRate	Memory Swap Out Rate	Rate at which memory is being swapped from active memory to disk during the current interval. This counter applies to virtual machines and is generally more useful than the swapout counter to determine if the virtual machine is running slow due to swapping, especially when looking at real-time statistics. ■ Stats Type: rate ■ Unit: kiloBytesPerSecond ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	•	o	o
swapped	Memory Swapped	Current amount of guest physical memory swapped out to the virtual machine's swap file by the VMkernel. Swapped memory stays on disk until the virtual machine needs it. This statistic refers to VMkernel swapping and not to guest OS swapping. swapped = swapin +swapout ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	o	o	o
swaptarget	Memory Swap Target	Amount of memory available for swapping. Target value for the virtual machine swap size, as determined by the VMkernel. The VMkernel sets a target for the level of swapping for each virtual machine, based on a number of factors. If Memory Swap Target is greater than Memory Swap, then the VMkernel will start swapping, causing more virtual machine memory to be swapped out. This will generally happen quickly. If Memory Swap Target is less than Memory Swap, then the VMkernel will stop swapping. Since swapped memory stays swapped until the virtual machine accesses it, Memory Swapped can be greater than Memory Swap Target, possibly for a prolonged period of time. This simply means that the swapped memory is not currently needed by the virtual machine and is not a cause for concern. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	o	o	o

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
swapunreserved	Memory Swap Unreserved	Amount of memory that is unreserved by swap. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	o	•	o	•
swapused	Memory Swap Used	Amount of memory that is used by swap. Sum of Memory Swapped of all powered on virtual machines and vSphere services on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	o	•	•	•
sysUsage	Memory Used by VMkernel	Amount of memory used by the VMkernel. Amount of machine memory used by the VMkernel for "core" functionality (such as its own internal uses, device drivers, etc). It does not include memory used by VMs or by vSphere services. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	•	•	•
totalmb	Memory Total	Total amount of machine memory of all hosts in the cluster that is available for virtual machine memory (physical memory for use by the Guest OS) and virtual machine overhead memory. Memory Total = Aggregate host machine memory - (VMkernel memory + Service Console memory + other service memory) ■ Stats Type: absolute ■ Unit: megaBytes ■ Rollup Type: average ■ Collection Level: 1 ■ VC/ESX: Yes/No	o	o	o	•
unreserved	Memory Unreserved	Amount of memory that is unreserved. Memory reservation not used by the Service Console, VMkernel, vSphere services and other powered on VMs' user-specified memory reservations and overhead memory. **NOTE** This statistic is no longer relevant to virtual machine admission control, as reservations are now handled through resource pools. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	o	•	o	o

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
usage	Memory Usage	Memory usage as percentage of total configured or available memory. **VM** `memory usage = memory active ÷ virtual machine physical memory size` **Host** `memory usage = memory consumed ÷ host configured memory size` **Cluster** `memory usage = memory consumed + memory overhead ÷ effectivemem` ■ Stats Type: absolute ■ Unit: percent ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	•	o	o
vmmemctl	Memory Balloon	Amount of memory allocated by the virtual machine memory control driver, which is installed with VMware Tools. **VM** Amount of guest physical memory that is currently reclaimed from the virtual machine through ballooning. This is the amount of guest physical memory that has been allocated and pinned by the balloon driver. **Host** Sum of Memory Balloon of all powered on virtual machines and vSphere services on the host. If the balloon target value is greater than the balloon value, the VMkernel inflates the balloon, causing more virtual machine memory to be reclaimed. If the balloon target value is less than the balloon value, the VMkernel deflate the balloon, which allows the virtual machine to consume additional memory if needed. Virtual machines initiate memory reallocation. Therefore, it is possible to have a balloon target value of 0 and balloon value greater than 0. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 1(4)	•	•	•	•

Table C-5. Memory Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
vmmemctltarget	Memory Balloon Target	Amount of memory that can be used by memory control. This is the target value for the virtual machine's Memory Balloon value, as determined by the VMkernel. The VMkernel sets a target for the level of ballooned memory for each virtual machine, based on a number of factors. If Memory Balloon Target is greater than Memory Balloon, the VMkernel inflates the balloon, causing more virtual machine memory to be reclaimed and Memory Balloon to increase. If Memory Balloon Target is less than Memory Balloon, the VMkernel deflates the balloon, allowing the virtual machine to map/consume additional memory if it needs it. Memory Balloon decreases as the VMkernel deflates the balloon. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	o	o	o
zero	Memory Zero	Amount of memory that is zeroed out (contains only 0s). This statistic is included in Memory Shared. **VM** Amount of guest physical zero memory that is shared through transparent page sharing. Zero memory is simply memory that is all zeroes. **Host** Sum of Memory Zero of all powered on VMs and vSphere services on the host. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: average (min/max) ■ Collection Level: 2(4)	•	•	o	o

Network Metrics

The network metric group tracks network utilization for both physical and virtual NICs (network interface controllers) and other network devices, such as the virtual switches (vSwitch), that support connectivity among all vSphere components (virtual machines, VMkernel, host, and so on).

Table C-6 lists the network data counters.

Table C-6. Network Data Counters

Counter	Label	Description	Entity V	H	R	C
droppedRx	droppedRx	Number of receive packets dropped during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 2	•	•	o	o
droppedTx	droppedTx	Number of transmit packets dropped during the collection interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 2	•	•	o	o

Table C-6. Network Data Counters (Continued)

Counter	Label	Description		Entity V	H	R	C
packetsRx	Network Packets Received	Number of packets received during the collection interval.		•	•	o	o
		VM	Number of packets received by each vNIC (virtual network interface controller) on the virtual machine.				
		Host	Total number of packets received on all virtual machines running on the host.				
		■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 3					
packetsTx	Network Packets Transmitted	Number of packets transmitted during the collection interval.		•	•	o	o
		VM	Number of packets transmitted by each vNIC on the virtual machine.				
		Host	Number of packets transmitted across each physical NIC instance on the host.				
		■ Stats Type: delta ■ Unit: number ■ Rollup Type: summation ■ Collection Level: 3					
received	Network Data Receive Rate	Average rate at which data was received during the collection interval. This represents the bandwidth of the network.		•	•	o	o
		VM	Rate at which data is received across each vNIC on the virtual machine.				
		Host	Rate at which data is received across each physical NIC instance on the host.				
		■ Stats Type: rate ■ Unit: megabitsPerSecond ■ Rollup Type: average ■ Collection Level: 3					

Table C-6. Network Data Counters (Continued)

Counter	Label	Description	Entity V	H	R	C
transmitted	Network Data Transmit Rate	Average rate at which data was transmitted during the collection interval. This represents the bandwidth of the network. **VM** Rate at which data is transmitted across each vNIC on the virtual machine. **Host** Rate at which data is transmitted across each physical NIC instance on the host. ■ Stats Type: rate ■ Unit: megabitsPerSecond ■ Rollup Type: average ■ Collection Level: 3	•	•	o	o
usage	Network Usage	Sum of the data transmitted and received during the collection interval. **VM** Sum of data transmitted and received across all virtual NIC instances connected to the virtual machine. **Host** Sum of data transmitted and received across all physical NIC instances connected to the host. ■ Stats Type: rate ■ Unit: Mbps ■ Rollup Type: average(min/max) ■ Collection Level: 1(4)	•	•	o	o

Storage Utilization Metrics

The disk metric group tracks statistics for datastore utilization.

Table C-7 lists the storage utilization data counters.

NOTE Storage metrics appear only in the overview performance charts.

Legend:

- D = Datastores
- V = Virtual Machines
- F = Filetypes

Table C-7. Storage Utilization Data Counters

Counter	Label	Description	Entity D	Entity V	Entity F
capacity	Storage Capacity	Configured size of the datastore. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: latest ■ Collection Level: 1	•	o	o
provisioned	Allocated	Amount of physical space allocated by an administrator for the datastore. Provisioned space is not always in use; it is the storage size up to which files on a datastore or virtual machine can grow. Files cannot expand beyond this size. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: latest ■ Collection Level: 1	•	•	o
unshared	Not-shared	Amount of datastore space that belongs only to the virtual machine and is not shared with other virtual machines. Only unshared space is guaranteed to be reclaimed for the virtual machine if, for example, it is moved to a different datastore and then back again. The value is an aggregate of all unshared space for the virtual machine, across all datastores. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: latest ■ Collection Level: 1	•	•	o
used	Used	Amount of space actually used by a virtual machine or a datastore. The used amount can be less than the amount provisioned at any given time, depending on whether the virtual machine is powered-off, whether snapshots have been created, and other such factors. ■ Stats Type: absolute ■ Unit: kiloBytes ■ Rollup Type: latest ■ Collection Level: 1	•	•	•

System Metrics

The system metric group tracks statistics for overall system availability. These counters are available directly from ESX and from vCenter Server.

Table C-8 lists the system data counters.

NOTE The system metrics appear only in the advanced performance charts, and only for hosts and virtual machines.

Table C-8. System Data Counters

Counter	Label	Description	Entity V	H	R	C
heartbeat	Heartbeat	Number of heartbeats issued per virtual machine during the interval. ■ Stats Type: delta ■ Unit: number ■ Rollup Type: sum ■ Collection Level: 1	•	•	o	o
resourceCpuUsage	Resource CPU Usage	Amount of CPU used during the interval by the Service Console and other applications. ■ Stats Type: rate ■ Unit: megaHertz ■ Rollup Type: average ■ Collection Level: 3(4)	•	•	o	o
uptime	Uptime	Total time elapsed, in seconds, since last system startup. ■ Stats Type: absolute ■ Unit: second ■ Rollup Type: latest ■ Collection Level: 1	•	•	o	o

Virtual Machine Operations Metrics

The virtual machine operations metric group (vmop) tracks virtual machine power and provisioning operations in a cluster or datacenter.

Table C-9 lists the virtual machine operations data counters.

NOTE The vmops metrics appear only in the advanced performance charts.

Table C-9. Virtual Machine Operations Data Counters

Counter	Label	Description
numChangeDS	VM datastore change count (non-powered-on VMs)	Number of datastore change operations for powered-off and suspended virtual machines. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numChangeHost	VM host change count (non-powered-on VMs)	Number of host change operations for powered-off and suspended VMs. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numChangeHostDS	VM host and datastore change count (non-powered-on VMs)	Number of host and datastore change operations for powered-off and suspended virtual machines. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1

Table C-9. Virtual Machine Operations Data Counters (Continued)

Counter	Label	Description
numClone	VM clone count	Number of virtual machine clone operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numCreate	VM create count	Number of virtual machine create operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numDeploy	VM template deploy count	Number of virtual machine template deploy operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numDestroy	VM delete count	Number of virtual machine delete operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numPoweroff	VM power off count	Number of virtual machine power off operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numPoweron	VM power on count	Number of virtual machine power on operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numRebootGuest	VM guest reboot count	Number of virtual machine guest reboot operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numReconfigure	VM reconfigure count	Number of virtual machine reconfigure operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numRegister	VM register count	Number of virtual machine register operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1

Table C-9. Virtual Machine Operations Data Counters (Continued)

Counter	Label	Description
numReset	VM reset count	Number of virtual machine reset operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numShutdownGuest	VM guest shutdown count	Number of virtual machine guest shutdown operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numStandbyGuest	VM standby guest count	Number of virtual machine standby guest operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numSuspend	VM suspend count	Number of virtual machine suspend operations. ■ Stats Type: absolute ■ Unit: number ■ Rollup Type: latest ■ Collection Level: 1
numSVMotion	Storage VMotion count	Number of migrations with Storage VMotion (datastore change operations for powered-on virtual machines). ■ Stats Type: absolute ■ Unit: number ■ Collection Level: 1 ■ Rollup Type: latest
numUnregister	VM unregister count	Number of virtual machine unregister operations. ■ Stats Type: absolute ■ Unit: number ■ Collection Level: 1 ■ Rollup Type: latest
numVMotion	VMotion count	Number of migrations with VMotion (host change operations for powered-on virtual machines). ■ Stats Type: absolute ■ Unit: number ■ Collection Level: 1 ■ Rollup Type: latest

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